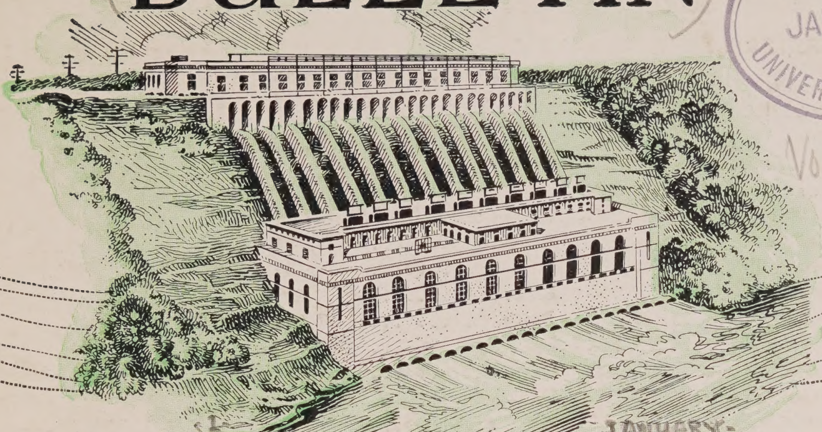
# THE BULLETIN





Vol. XXI No. 12 JANUARY- DECEMBER, 1934

## Hydro-Electric Power Commission of Ontario

*Administration Building Entrance, Christmas, 1934.*



# HYDRO MUNICIPALITIES

*(Populations shown are from the last government report excepting where more recent figures have been furnished by the municipalities.)*

## EASTERN SYSTEM

| | |
|---|---|
| Alexandria | 2,370 |
| Apple Hill | 350 |
| Arnprior | 4,072 |
| Athens | 614 |
| Bath | 289 |
| Belleville | 13,899 |
| Bloomfield | 637 |
| Bowmanville | 3,604 |
| Braeside | 550 |
| Brighton | 1,343 |
| Brockville | 9,988 |
| Cardinal | 1,249 |
| Carleton Place | 4,278 |
| Chesterville | 1,000 |
| Cobden | 631 |
| Cobourg | 5,619 |
| Colborne | 965 |
| Deseronto | 1,331 |
| Finch | 365 |
| Hastings | 656 |
| Havelock | 1,142 |
| Kemptville | 1,227 |
| Kingston | 22,368 |
| Lakefield | 1,428 |
| Lanark | 592 |
| Lancaster | 560 |
| Lindsay | 7,161 |
| Madoc | 1,019 |
| Marmora | 1,013 |
| Martintown | 357 |
| Maxville | 742 |
| Millbrook | 714 |
| Napanee | 2,984 |
| Newcastle | 590 |
| Newburgh | 433 |
| Norwood | 756 |
| Omemee | 489 |
| Orono | 700 |
| Oshawa | 25,550 |
| Ottawa | 137,911 |
| Perth | 4,057 |
| Peterboro | 22,798 |
| Picton | 3,146 |
| Port Hope | 4,415 |
| Portsmouth | 679 |
| Prescott | 3,078 |
| Richmond | 367 |
| Russell | 500 |
| Smith's Falls | 7,452 |
| Stirling | 822 |
| Trenton | 5,775 |
| Tweed | 1,206 |
| Warkworth | 500 |
| Wellington | 900 |
| Westport | 635 |
| Whitby | 5,463 |
| Williamsburg | 200 |
| Winchester | 970 |
| Total | 323,499 |

## GEORGIAN BAY SYSTEM

| | |
|---|---|
| Alliston | 1,364 |
| Arthur | 954 |
| Bala | 336 |
| Barrie | 7,166 |
| Beaverton | 988 |
| Beeton | 561 |
| Bradford | 933 |
| Brechin | 255 |
| Cannington | 849 |
| Chatsworth | 251 |
| Chesley | 1,702 |
| Coldwater | 563 |
| Collingwood | 6,027 |
| Cookstown | 635 |
| Creemore | 598 |
| Dundalk | 659 |
| Durham | 1,744 |
| Elmvale | 600 |
| Elmwood | 350 |
| Flesherton | 448 |
| Grand Valley | 590 |
| Gravenhurst | 1,822 |
| Hanover | 3,102 |
| Hepworth | 327 |
| Holstein | 285 |
| Horn ng's Mills | 350 |
| Huntsville | 2,903 |
| Kincardine | 2,511 |
| Kirkfield | 138 |
| Lucknow | 1,115 |
| Markdale | 812 |
| McTier | 450 |
| Meaford | 2,708 |
| Midland | 7,116 |
| Mount Forest | 1,888 |
| Neustadt | 460 |
| Orangeville | 2,772 |
| Owen Sound | 12,778 |
| Paisley | 716 |
| Penetanguishene | 3,767 |
| Port Carling | 439 |
| Port Elgin | 1,203 |
| Port McNicholl | 825 |
| Port Perry | 1,288 |
| Priceville | |
| Ripley | 410 |
| Shelburne | 1,133 |
| Southampton | 1,700 |
| Stayner | 949 |
| Sunderland | 570 |
| Tara | 455 |
| Teeswater | 835 |
| Thornton | 200 |
| Tottenham | 538 |
| Uxbridge | 1,482 |
| Victoria Harbor | 950 |
| Walkerton | 2,280 |
| Waubaushene | 600 |
| Wiarton | 1,880 |
| Windermere | 124 |
| Wingham | 2,229 |
| Woodville | 403 |
| Total | 94,083 |

## NIAGARA SYSTEM

| | |
|---|---|
| Acton | 1,951 |
| Agincourt | 612 |
| Ailsa Craig | 516 |
| Alvinston | 657 |
| Amherstburg | 3,083 |
| Ancaster Twp. | 3,119 |
| Arkona | 383 |
| Aurora | 2,623 |
| Aylmer | 1,996 |
| Ayr | 776 |
| Baden | 710 |
| Beachville | 503 |
| Beamsville | 1,185 |
| Belle River | 715 |
| Blenheim | 1,630 |
| Blyth | 621 |
| Bolton | 609 |
| Bothwell | 575 |
| Brampton | 5,137 |
| Brantford | 32,786 |
| Brantford Twp. | 7,595 |
| Brigden | 400 |
| Bridgeport | 500 |
| Bronte | 400 |
| Brussels | 725 |
| Burford | 700 |
| Burgessville | 300 |
| Burlington | 3,403 |
| Caledonia | 1,456 |
| Campbellville | 200 |
| Cayuga | 661 |
| Chatham | 16,441 |
| Chippawa | 1,222 |
| Clifford | 496 |
| Clinton | 1,911 |
| Comber | 800 |
| Cottam | 333 |

THE
BULLETIN
Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario
620 University Ave.
Toronto
Subscription Price $2.00
Per Year

# A Brief Review of Hydro Activities During 1933*

By The Honourable J. R. Cooke, Chairman, Hydro-Electric Power Commission of Ontario

AT this time when the view is widely held that there are definite evidences of a tendency towards relief from a prolonged period of exceptional economic stress, it is a gratification to the Hydro-Electric Power Commission, which is entrusted with the administration of the great co-operative electrical undertaking of Ontario municipalities, to be able to contribute a word of encouragement.

The outstanding feature of Hydro experience during 1933 has been the evidence afforded that the enterprise, in passing through a period of severe test, can not only maintain a sound position but can even record substantial advancement in important directions.

Some ten new municipalities were served during 1933. The Commission now serves 757 Ontario municipalities, including 27 cities, 96 towns, 269 villages and police villages and 365 townships. A department of the Commission's activities that, even under the most adverse circumstances, has continued to expand year by year without interruption, is the distribution of rural electrical service. Applications from new rural consumers were received in 1933, which justified the Commission in authorizing the building of no less than 320 miles of primary distribution line in its rural power districts, bringing the total mileage to more than 9,170 miles, in which there is invested some $20,110,000, of which nearly $10,000,000 has been granted by the Government in pursuance of its long-established policy of assistance to agriculture. Nearly 62,000 farm and hamlet consumers are served in rural power districts, a number more than twice the total number of consumers in the border municipalities.

During the Commission's fiscal year which ended on October 31, 1933, general business and industrial activities throughout the Dominion

*A statement copied from the "Yearly Review" issue of *The Border Cities Star*, December 30, 1933, Windsor, Ontario.

CONTENTS

Vol. XXI No. 1

JANUARY, 1934



averaged even lower than they had been in the preceding year, and this inevitably tended to curtail demands for industrial power. The total demands for industrial and other general purposes upon the Commission's systems were, nevertheless, well maintained, and in the last half of the year these demands showed substantial advance over the corresponding period of 1932. In addition, the Commission has been able to arrange by special contract for the utilization, at such times as it may be available, of a substantial part of the reserve capacity that it must maintain in readiness to enable idle and semi-idle industries to re-employ their workmen when times improve.

Financial results of the Hydro undertaking for the year 1933 will reflect, of course, not only the relatively favourable circumstances that existed at the end of the year, but also the relatively adverse business conditions of early months. Nevertheless, it is anticipated that, when the data have been assembled following the close of the fiscal year of the Hydro municipalities, which comes at the end of December, an eminently satisfactory position will be recorded. Several million dollars will have been added to the reserves which safeguard the Hydro undertaking, bringing *the additions* to reserves that have been made by the Commission and the municipalities during the past four years up to more than $35,000,000. This large recent increase in financial reserves is the more noteworthy in that it has been accomplished while in the same period reductions in rates to consumers have been granted in a large number of municipalities, and in many others the consumers have received cash rebates in respect of a portion of their payments for Hydro service.

The returns from the Hydro Utilities of the co-operating municipalities will not come in until after the close of their financial year on December 31st. The magnitude of the Hydro undertaking, however, is well represented by 1932 figures previously published. The capital investment by the Commission on behalf of the co-operative enterprise in generating plants, transmission lines and other collective undertakings exceeds $273,000,000. The capital investment by the municipalities in distributing systems and other assets exceeds $109,000,000. The total investment in the undertaking is thus no less than $382,000,000. The total reserves of the Commission and municipal utilities exceed $122,000,000.

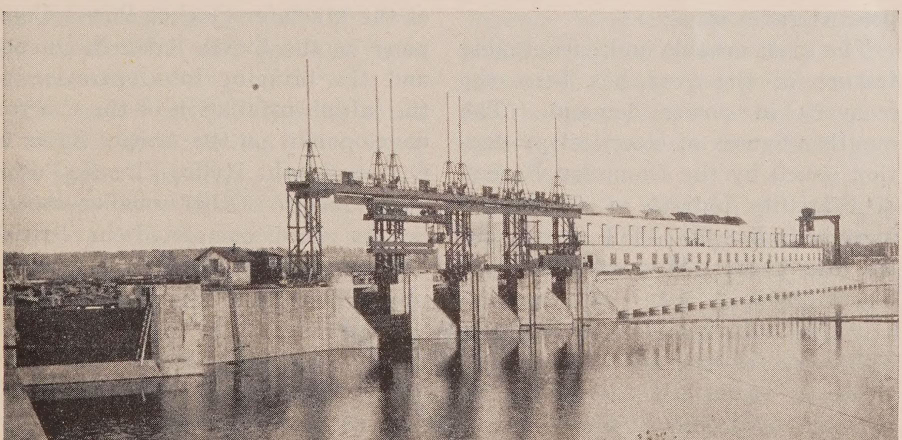
In Northern Ontario, the Commission on behalf of the Government, has been active in making available low-cost power for mining and other purposes. Three additional contracts

have been consummated for the sale of power from the Abitibi Canyon development, and others are under negotiation. As a result of these contracts, and of the favourable terms on which the development was acquired—involving reduction of annual bond interest cost from $1,100,000 plus United States exchange to $630,000—the Commission is confident that the development will be on a self-supporting basis at an early date. The stimulus afforded to the mining of low-grade gold ores may be expected to re-act to the benefit of the whole Province and Dominion, accelerating the process of economic recovery.

With respect to the outlook for 1934 and the future, the clearly discernible improvement in the later months of 1933, as compared with the earlier months, which has quite generally been observed in connection with various economic indices, finds confirmation in the Commission's records of power utilization, and affords substantial ground for hope that the Province of Ontario is in process of industrial and business recovery.

The Commission's power reserves now in hand, although earning a revenue, are still available for general industrial and business uses as they may be needed. These reserves, together with the power supplies arranged for delivery in 1934 to 1937, are sufficient to enable the industrial and business activities of Ontario, which in recent years have in large measure been suspended, to proceed with confidence along the path of recovery that has been entered, in the knowledge that "Hydro" power supplies will be forthcoming in quantity ample for a moderately rapid resumption of former activities.

Ontario's co-operative municipal enterprise has stood the test of adverse economic conditions in a splendid way and with strong financial resources and adequate power supplies, it is in an excellent position to function efficiently in aiding the return of prosperity.



# Hydro-Electric Progress in Canada in 1933

*(From Bulletin No. 1727, Dominion Water Power and Hydrometric Bureau, Department of Interior, Ottawa.)*

THE annual review of hydro-electric progress in Canada, prepared by the Dominion Water Power and Hydrometric Bureau of the Department of the Interior, discloses that no new water-power undertakings of magnitude were initiated during 1933. However, work was continued on several developments already under construction at the beginning of the year and, as a result, new installations were completed and brought into operation totalling 270,210 horsepower. This addition, together with 16,600 horsepower in new installations completed in 1932, but not previously included in the total for that year, brings the total for the Dominion at the end of 1933 to a figure of 7,332,070 horsepower. This figure will be increased in 1934 and subsequent years, resulting from the construction of several undertakings at present under way.

The most notable and encouraging feature of the year has been the recovery in power demand. The monthly figures of electrical production issued by the Dominion Bureau of Statistics indicate a substantial increase over the 1932 figures for the months from May onward. Production in July, August, September and October was higher than has been recorded in the corresponding months in any previous year, in fact, the figures for the month of October constituted an all-time high for any month. At this time, figures for November and December are not available, but if these months sustain the increase recorded in the past few months, the total production for the year will not be much short of 1930, the highest year of record. While the gain has been general throughout the Dominion it has been most pronounced in the Provinces of Ontario and Quebec. In the latter province all-time high figures have been recorded, while in Ontario the load recovery has also been most substantial.

The increase in installation during 1933 resulted chiefly from the completion of the Masson development of the Maclaren-Quebec Power Company on the Lievre River in Quebec and the bringing into operation of the initial installation of the Canyon development on the Abitibi River in Ontario by the Hydro-Electric Power Commission. Other smaller installations were completed in British Columbia.

# Preservation of Wooden Poles

**By C. E. Schwenger, Distribution Engineer, and F. X. Brady, Assistant Engineer, Toronto Hydro-Electric System**

THE preservation of wooden poles involves a study of the causes of wood decay and the choice of preservatives available for the prevention of this decay. All wooden structures or timbers which are set or placed in contact with the earth, such as is the case with wooden poles, are subject to deterioration and decay. This decay depends upon the species of the wood and the nature of the soil in which it is placed.

### Causes of Wood Decay

The decay of wood is generally due to the activities of certain low forms of plant life, known as fungi. These plants have their origin in minute spores borne from place to place by the wind. These may lodge and find a suitable condition for growth, which may be on living or dead timber. They germinate, provided the conditions are favourable, and at once attack the wood, drawing their sustenance partially from the atmosphere and partially from the wood cells.

The action of the various forms of fungi is quite similar. They grow with great rapidity, sending out numerous thread-like tentacles which penetrate into the wood and attack the contents of the cells, the sugar, starches and oils and finally the cell walls.

The most favourable conditions for the growth of fungi and other organisms of decay are—an abundant food supply, heat, moisture and air. Exclude any of the four and fungus growth ceases.

Moisture, air and favourable temperature for fungus development are present almost everywhere and particularly at the ground line area of line poles, fence posts or any structural timber set in the earth. Of the four factors, therefore, the one which may be controlled to combat fungus attack is the food supply and this is accomplished by the injection of antiseptic or germicidal chemical agents into the wood cells and thereby poison the food of the fungi.

### Choice of Preservative

Various antiseptic or germicidal agents have been used for the protection of timber against fungus attack which may be classed under two headings—oils and salts.

The most important of the oils are coal tar creosote or dead oil of coal tar and other similar trade compounds. Of the salts, zinc chloride, mercury bichloride and copper sulphate are quite extensively used for structural timber preservation; but for the preservation of wood poles coal tar derivatives are most generally used.

Creosote, or dead oil of coal tar is a by-product of coal tar in the manufacture of illuminating gas and by-product coke. Tar is distilled and the condensed vapours are separated into the light oils or naptha, the dead oil or creosote, and pitch. Creosote is not a simple substance but contains a large number of chemical

constituents. At 65 deg. fahr. it weighs about 8.7 lb. per gallon; at 100 deg. fahr. the specific gravity ranges from 1.03 to 1.09. It has high antiseptic properties and is insoluble in water.

There are several grades of coal tar creosote recognized in the trade which are distinguishable chiefly by their specific gravities and percenttages of low and high boiling compounds. The heavier oils are considered the more valuable.

A difference of opinion exists as to the desirable components of creosote. In view of this fact most creosote specifications confine themselves to the requirements that the material be a straight product of coal tar distillation, free from adulteration, with limited material insoluble in benzole and that certain definite percentages distil at standard temperatures.

Coal tars contain many hydrocarbons, or neutral oils (including napthalene) and phenols, or tar acids, of varying grades. The phenols are specifically effective against dry rot, fungus growths and all other lower organisms which attack wood. The higher the boiling point of the phenol the more effective it is in destroying lower organisms. But the higher the boiling point the more viscous do the oils become and, therefore, the less do they penetrate the wood to which applied.

"Penetration varies inversely as the viscosity increases" (Weiss), while napthalene, which is present to varying degrees in coal tar oils, tends to reduce penetration inasmuch as it crystallizes in the pores of the wood.

In the selection of a creosote preservative, where penetration is desired, an oil not too viscous having high phenol content and low napthalene content, would appear satisfactory. Various tests, observations and recorded data indicate that of the commonly used preservative agents the coal tar derivatives have proven the better germicide or preservative for wood poles.

Recorded data which appears to bear out this contention is as follows:

"Prior to 1914 a report from The German Government Telegraph Department was issued on 'The Relative Life and Value of Wooden Poles,' the statistics supplied go back to North German and even the Prussian Telegraph System of 1852, and cover a period of more than fifty years experience with various wood preservatives. Thousands of poles of all species tested with various preservatives were under observation and one interesting conclusion arrived at is given in terms of average life of poles under various preservatives:

"Untreated, Average Life . . . 7.7 yrs.
"Copper Sulphate, Average Life . . . . . . . . . . . . . . . . . . . 11.7 yrs.
"Zinc Chloride, Average Life 11.9 yrs.
"Corrosive Sublimate, Life . . 13.7 yrs.
"Dead Oil of Coal Tar, Life. 20.6 yrs."

Further recorded data on various methods of treatment with various preservative materials have been furnished by the A. T. and T. Co., in connection with tests on its Omaha-Denver Line and another on Experimental Western Red Cedar Poles in and around Los Angeles, California, which are shown in Tables I and II.

TABLE I

CONDITION OF EXPERIMENTAL NORTHERN WHITE CEDAR POLES AFTER NINETEEN YEARS SERVICE ON OMAHA-DENVER LINE, A.T. AND T. CO.
INSPECTION DATE—1929. ERECTED—1910

| Preservative used—Sold as | Treatment—Butts only | Average absorption of pres. Lb. per pole | Condition | Poles set in 1910 No. | Good No. | Good % | Decaying No. | Decaying % | Removed on account of decay No. | Removed on account of decay % | Removed on account of other causes % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Carbolineum (Avenarius) | Brush—two coats | 3.9 | Seasoned | 91 | 8 | 8.8 | 6 | 6.6 | 65 | 71.4 | ..... |
| Coal Tar Creosote | Brush—two coats | 4.4 | Seasoned | 95 | .. | .... | 2 | 2.1 | 82 | 86.3 | ..... |
| Coal Tar Creosote | Open tank | ... | Green | 43 | 17 | 39.6 | 9 | 20.9 | 9 | 20.9 | ..... |
| Coal Tar Creosote | Open tank | 48 | Seasoned | 138 | 58 | 42.1 | 1 | 0.7 | .. | .... | 57.2a |
| None | Untreated | ... | Seasoned | 96 | .. | .... | .. | .... | 91 | 94.8 | ..... |

a—Includes poles removed on account of storm breaks, line alterations, woodpeckers' attacks, etc., as well as those for which no record was made of cause of removal.

TABLE II

CONDITION OF EXPERIMENTAL WESTERN CEDAR POLES AFTER ABOUT TWENTY-ONE TO TWENTY-THREE YEARS SERVICE IN AND AROUND LOS ANGELES, CALIFORNIA

| Preservative used—Butts only | Absorption Lb. per pole | Poles set, 1907–09 No. | Butts good, Tops good, No. | Butts good, Tops good, % | Removal on account of butt decay No. | Removal on account of butt decay % |
|---|---|---|---|---|---|---|
| Carbolineum Brush—Two Coats | 5.3 | 29 | .. | ... | 22 | 75.9 |
| Creosote (a) Brush—Two Coats | 6.5 | 27 | .. | ... | 16 | 59.3 |
| Creosote (a)—Open Tank | 31.0 | 194 | 9 | 4.6 | 21 | 10.8 |
| Zinc Chloride—Open Tank | 0.5 (c) | 58 | .. | ... | 31 | 53.5 |
| Creosote (a)—Zinc Chloride—Hot Bath Creosote | 0.25, Zinc (c) 0.7, lb. Creos. (f) | 30 | .. | ... | 11 | 36.7 |
| Untreated | ..................... | 31 | .. | ... | 26 | 83.9 |

*Report of Forest Service, U.S. Department of Agriculture:*
(a) Purchased as a coal tar derivative but tests of specific gravity, index of refraction and sulphonic residues indicates that it was a water gas product.
(c) Dry zinc chloride per cu. ft.
(f) Per cubic foot.

From the above tabulations it would appear that the coal tar oil derivatives have preference over all other known forms of wood preservatives. The heavier oils sold under various trade names are best suited for brush treatment of poles and may last somewhat longer in the wood before ultimately leaching out. Renewal of the preservative is practised from time to time. The lighter and cheaper oils contain sufficient toxicity and penetrate deeper than would be the case with heavier or more expensive oils. On the Toronto System a medium light oil and the open tank butt treatment of poles, and in the maintenance treatment of poles, sleeves, which will be described later, has been used for the past 10 years and has been found to be very satisfactory as to toxic value and penetration into the wood.

### Choice of Treatments

There are three general methods in common use for creosote preservative treatment of wood poles, brush treatment, open tank treatment and pressure treatment.

The brush treatment of poles consists in applying hot creosote to the surface of the pole with a brush. The creosote is heated in a tank or pail to a temperature between 150 and 200 deg. fahr. The hot preservative is then applied to the timber surface with a stiff brush. While this method of treatment for poles is far better than none its life in the timber is relatively small in comparison with the other treatments.

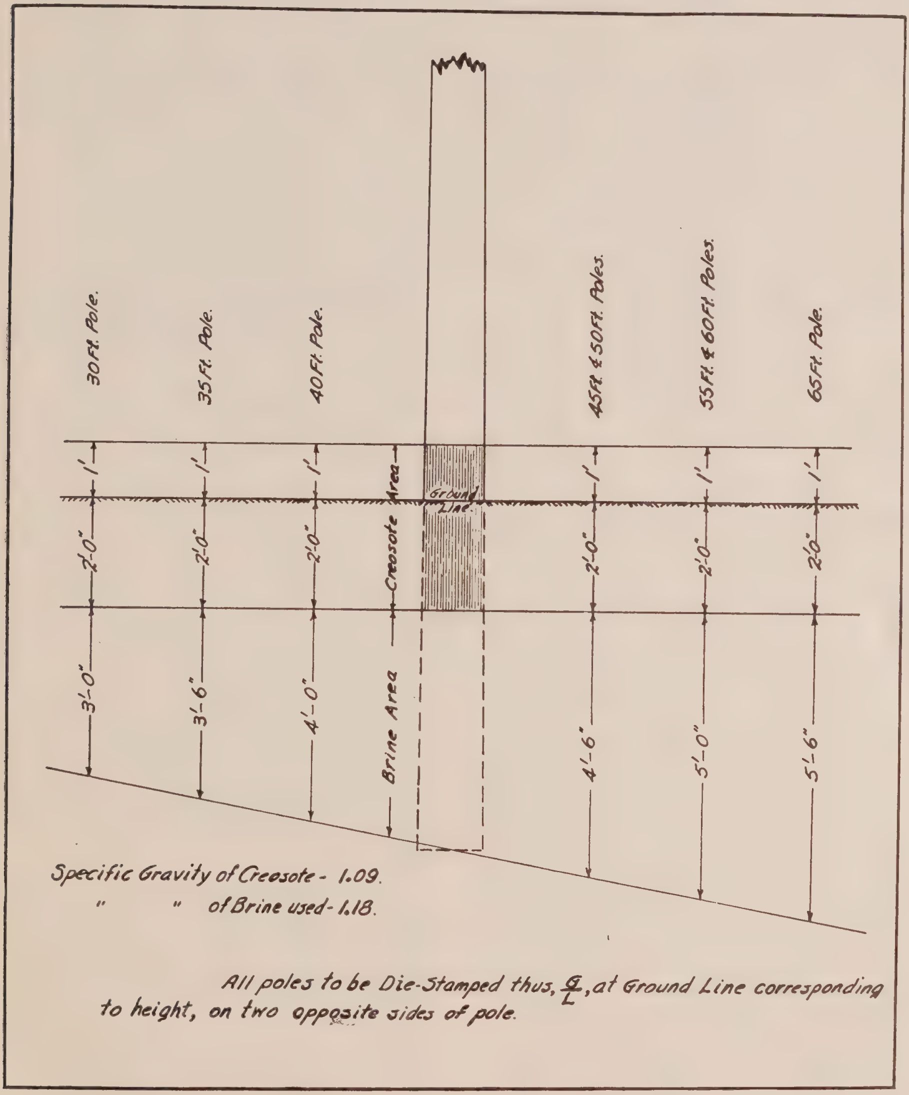
In the open tank process three methods of treating have generally been used. Treatment "A" consists of dipping the pole butts in boiling carbolineum and allowing them to remain for 15 minutes. Treatment "AA" is the same except that creosote is used instead of carbolineum. Treatment "B" provides for submersion of the pole butts in hot creosote for several hours, after which the bath is changed to cold creosote, the duration of each immersion depending upon several factors, but principally upon the degree to which the timber has been seasoned.

The principle of the open tank process is to force the preservative into the wood by the use of atmospheric pressure. The butts of the poles are submersed in the hot preservative in the treating tank which is maintained at a temperature of 210 to 220 deg. fahr. for at least four hours. After the hot bath, the oil is allowed to cool or the timber removed to a cool bath. The principle of the process is that the air in the wood is expanded by the heating and when cooled contracts and draws the preservative into the wood.

On the Toronto System we have been using the "B" treatment for more than 15 years and have found the process quite satisfactory. We have, within the past two years, however, made important changes in connection with butt area treatment. It is a well-known fact that the danger zone in a wood pole is in that area extending from just above the ground line to a point approximately 18 inches to 24 inches below ground. A pole butt very rarely decays below this depth, therefore, any treatment or preservative absorbed in this area is of no value in prolonging the life of a pole. With this in mind it

occurred to us that a way could be found to treat the danger area only and this was finally accomplished in a very simple manner. This treatment we have termed the creosote and salt brine open tank treatment.

The principle of the treatment is to limit the preservative impregnation to that area subject to fungus attack and decay, i.e., approximately 18 in. above and below the ground line, thereby effecting an approximate saving of 50 per cent. of the preservative and approximately 30 per cent. of heat. To accomplish this it simply means to float the creosote oil of a required depth on a liquid body of higher specific gravity.




*Creosote and brine treatment for cedar poles.*

In checking this treatment before putting into actual practice, a laboratory test was made with unheated creosote oil. In a 250 cu. cm. beaker, salt-saturated water to specific gravity of 1.20 and creosote oil at 1.09 specific gravity were poured. The creosote oil 2 cm. thick floated on the brine 4 cm. deep. Repeated agitation and mixing did not change this condition.

A piece of wood 3 inches long by 1.2 by 3 cm. cross-section was left in the solution over night (approximately 16 hours). There was 3 mm. penetration at the creosote zone with superficial coating beneath from contact with creosote when entering and leaving the container.

Before actual treatment of the poles by this process, two old 200 kv-a. transformer cases were set up adjacent to and above the dipping tank at the pole yard. Pipe and valve connections from the containers to the tank were made and the heating coils were moved up in the tank to the creosote area. One container was used for mixing salt brine (specific gravity 1.18 to 1.20), the other was used for creosote. Brine and creosote to the required level was run into the dipping tank and several batches of poles were put through on the usual 4-hour, 16-hour run, i.e., 4 hours hot and a cool out of 16 hours. All pieces were satisfactorily treated in the ground line area 3 to 3½ feet. The penetration at this point was good (average ⅜ to ¾ in. depending on sap wood thickness), with only a superficial coating of creosote below this area to the butt. The creosote was heated to 212 deg. fahr. The brine at the lower level rose to about 100 deg. fahr. The temperature in the lower level remained at all times at about 50 per cent. of the temperature of the creosote above. The loss in brine was comparatively light, approximately 25 gal. per 100 poles. Two tons of salt were used in making up 1,000 gallons of brine of 1.18 specific gravity at a cost of about 2 cents per gallon.

The accompanying diagram clearly shows the method of zone impregnation of poles or posts. In Fig. 1 is shown a pole set in the ground, rot or decay invariably starts at the point marked "B" which is at the ground level. The lower portion of the pole "D" is rarely affected. The area "C" which is shown shaded is that portion of the pole requiring impregnation.

Figure 2 shows a cross-section through the treating tank. The tank proper is shown at "E" and built of boiler plate surrounded with concrete. The lower or flotation liquid of high specific gravity is shown at "F" and steam coils for heating creosote at "H" and vertical boiler for supplying heat at "J".

Two separate tanks "L" and "M" are used for storage of reserve supply of flotation liquid and creosote. Tank "L" is fitted with steam supply to accelerate the mixing of the salt with water.

The creosote is heated to the required temperature, the poles are placed in the tank in an upright position, the butt of the pole passed through the creosote carrying down with it a thin film of creosote which serves to prevent an undue absorption of the flotation liquid. The area

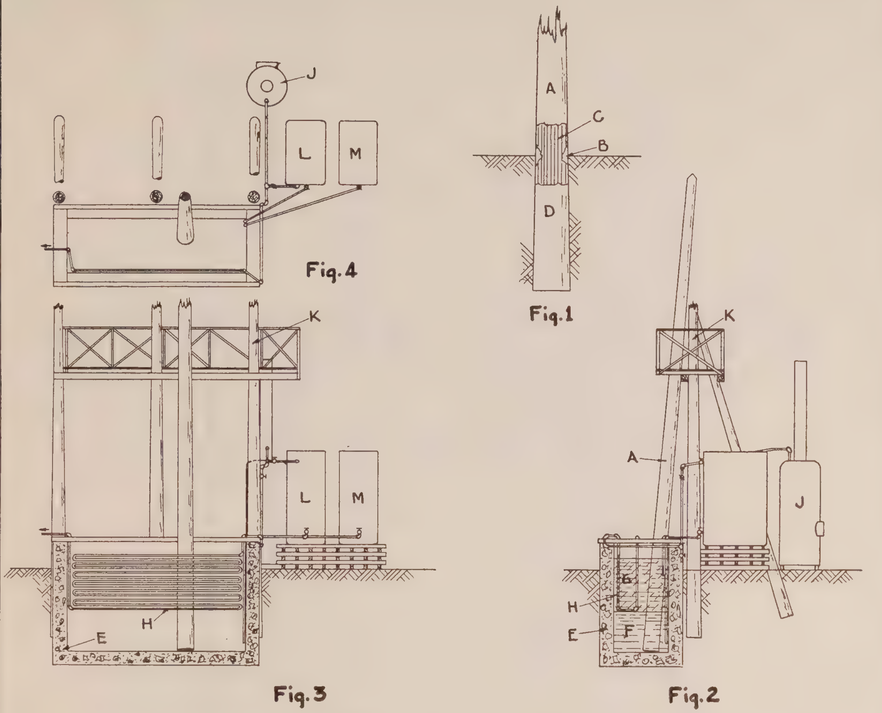



DIAGRAM SHOWING METHOD OF ZONE IMPREGNATION OF POLES AND POSTS

of the pole requiring treatment remains in the creosote zone during impregnation and is subject to full action of the preservative for any desired length of time.

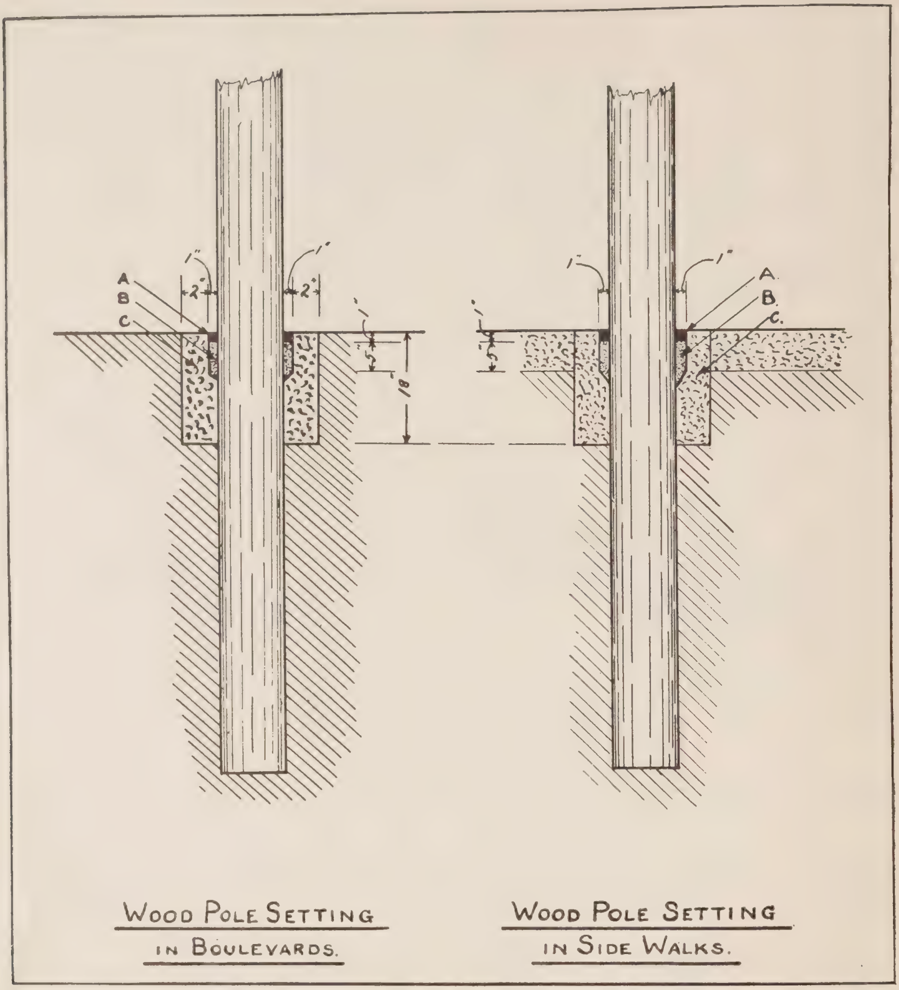
In 1932 one thousand poles were treated by this method and, in comparison with the full butt treatment, the difference in the amount of creosote used was approximately 50 per cent.

The pressure treatment is not considered, as this involves the treating of the whole pole from top to bottom with creosote in a special chamber under pressure. This method is not used on cedar poles but is applied generally to pine poles, which require treatment throughout their full length and are not considered in this article.

## PRESERVATIVE TREATMENT APPLIED TO STANDING POLES

In addition to the initial butt treatment of poles, the Toronto Hydro-Electric System has for the past ten years used a maintenance treatment for standing poles with satisfactory results. This might be called a "continuous impregnation system" of pole preservation.

In order to maintain the highest degree of efficiency in the application of preservatives to wooden poles, it is essential that some method be adopted to replace preservative which

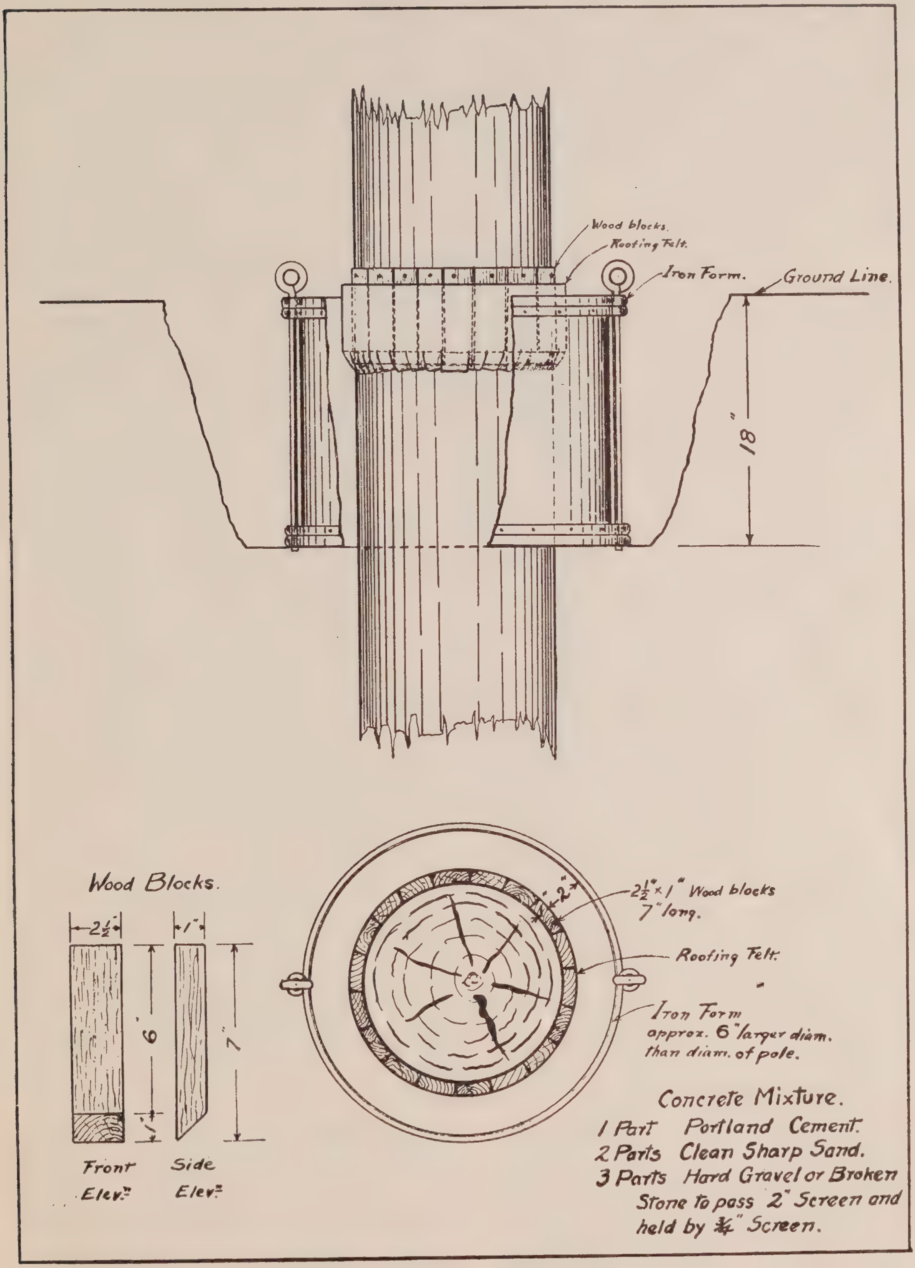



*Protective sleeves installed on wood poles. A—Coal tar pitch, 1 in. thick. B—Mixture of creosote, pea gravel and sand. C—Concrete sleeve.*

has evaporated or has been washed out of the timber by rain, while serving as an antiseptic in the manner described above. It is obvious that the washing away of the preservative allows the timber to become open to attack by fungi, therefore, in order to secure the longest life possible from poles, it is essential that the presence of preservative be kept continuously at high strength.

In 1921 the idea was conceived that a continuous preservative treatment could be successfully carried out and, after various experiments, the protective sleeve was designed and a number placed in service. After two years of observation it appeared that the idea was sound and that the life of poles could be greatly prolonged by the use of this sleeve at a moderate cost.

The protective sleeve, described in detail by drawings shown herewith, is simple in its application and principle. The sleeve consists of a con-




*Forms for concreting and preservation of wood poles.*

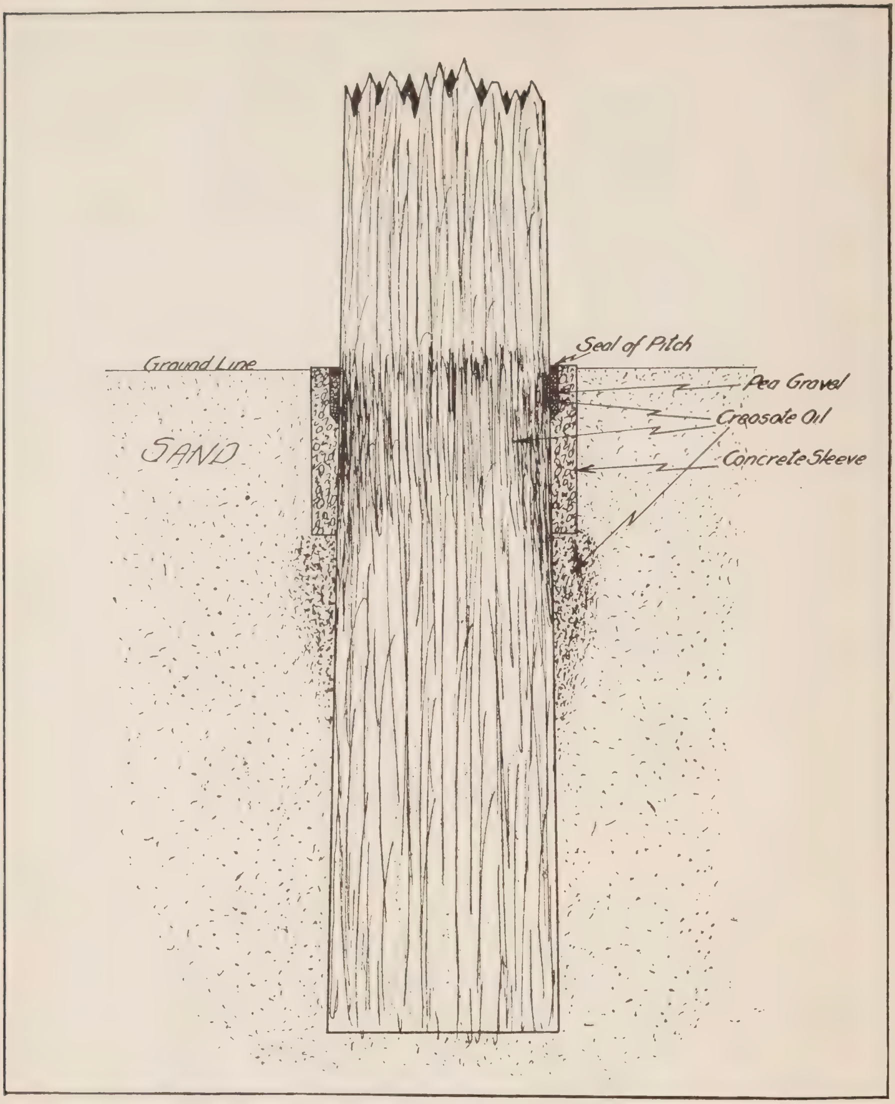



*Diagram showing condition found on examination of concrete sleeve after two years service.*

crete ring completely surrounding the pole from the ground line to about 18 inches below; between the inside of the ring and the pole is left a pocket which is filled with pea gravel and creosote, then sealed around the top with a tar pitch compound.

Primarily, it established an antiseptic zone around the pole. Its first line of defence against attacking fungi extends around that portion of the pole most usually attacked. From the ground line to approximately eighteen inches below, the

zone remains unbroken and continues to a greater depth by saturation of the earth with the creosote, caused by passage of rain water—also the creosote, through capillary action, enters the wood, penetrating the cell walls to become an integral part of the timber.

By use of this continuous preservative treatment and by refilling sleeves at intervals, of say three to four years, the life of the pole may be prolonged for many years at a small expense.

The refilling of the sleeve is a very simple operation. The pitch seal is punctured in two places, the creosote is forced through one opening with a force pump, the holes are then resealed and the poles are protected for another four years.

The cost of the initial installation of the sleeve will average approximately $6.00 each where set in pavements and approximately $4.00 each where set in boulevards. Refilling costs are comparatively low. During the years of 1931, 1932 and 1933, approximately 16,000 sleeves were refilled at an average cost of about 60 cents each.

It is only reasonable to expect that the original treatment will protect the pole from fungus attack only during its life in the wood, which is generally estimated at seven years. With the maintenance treatment before the end of this period, the supply of preservative is replenished and repeated at intervals of three to four years, thereby deferring the day of ultimate replacement.

The Toronto Hydro - Electric System system of continuous impregnation of standing wood poles has been followed in development of a device in the form of a lead pipe wound around the pole just below the ground line. This lead pipe replaces the concrete sleeve used by the Toronto Hydro-Electric System. This lead pipe is perforated by wood nozzles which are continued into the wood pole and through capillary action the creosote is led into the wood. This arrangement is shown in the attached cut.

Another method of maintenance treatment is of Swedish origin and is known as the Farnos Method. According to reports this method is quite extensively used in Europe. It consists of uncovering the pole approximately two feet below ground and this area is charred with a portable burner until ⅛ of an inch of charcoal is formed entirely around the pole. While still hot the pole is treated with creosote, through a spraying apparatus.

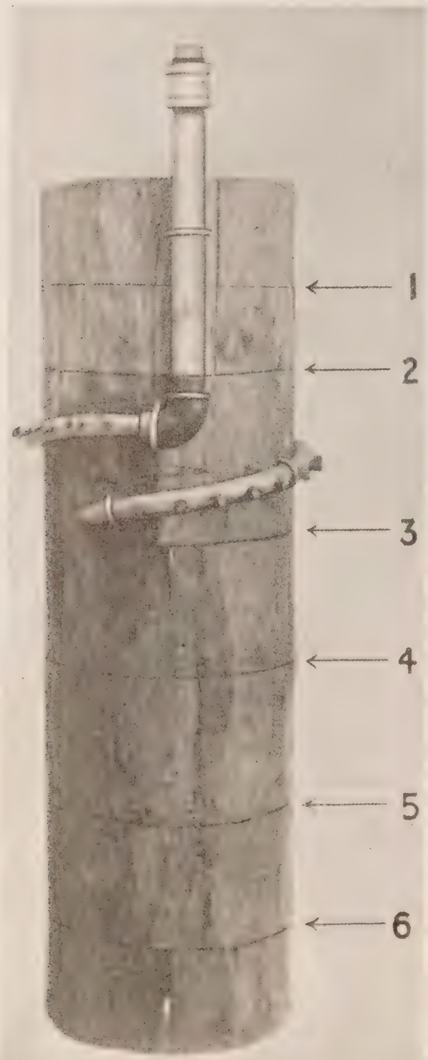
The claims for this method are that when the wood is burnt the air expands from the heat. As the cool creosote contacts the wood the remaining small quantity of air contracts, leaving a vacuum which soaks up the oil. When the wood absorbs its limit of creosote during the heat period then the charcoal soaks up a considerable quantity, which is then gradually given off to the sound wood.

The estimated cost of the above treatment is approximately $3.25 per standing pole, as against $4.00 for the sleeve method. However, the refilling operation on the sleeve method is approximately .62 cents per pole, as against $3.25 for the charring method.

Still another process for maintenance treatment of standing poles

is of German origin, known as the "Cobra Process of Wood Preservation." The preservative used in this case consists of a paste which is described as being composed of 15 per cent. of sodium di-nitro phenate and 85 per cent. of sodium fluoride which, after being injected into the poles, is covered with a coating known as celoyd, composed of creosote and basilineum, the latter being a naphylamine and di-nitro chlorbenzole.

The preservative paste in this instance is injected into the pole with a tool known as an Impregnating Hammer, working on the principle of a hypodermic needle. In construction it is a container shaped in hammer fashion with the head cosisting of a hollow steel needle with perforated sides. This instrument is filled with the preservative paste and




*Lead pipe method of ground line pole treatment.*

*Western cedar, 12 in. diameter pole, 60 day solignum, 13 in. above incision.*

*Western cedar, 12 in. diameter pole, 60 day solignum, 13 in. below incision.*

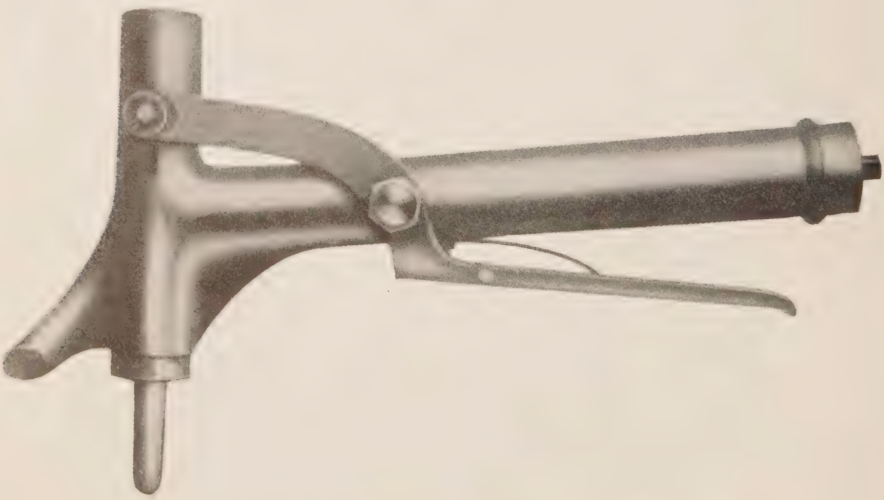
*Cross section of pole after treatment with lead pipe unit.*

*Charring operation.*

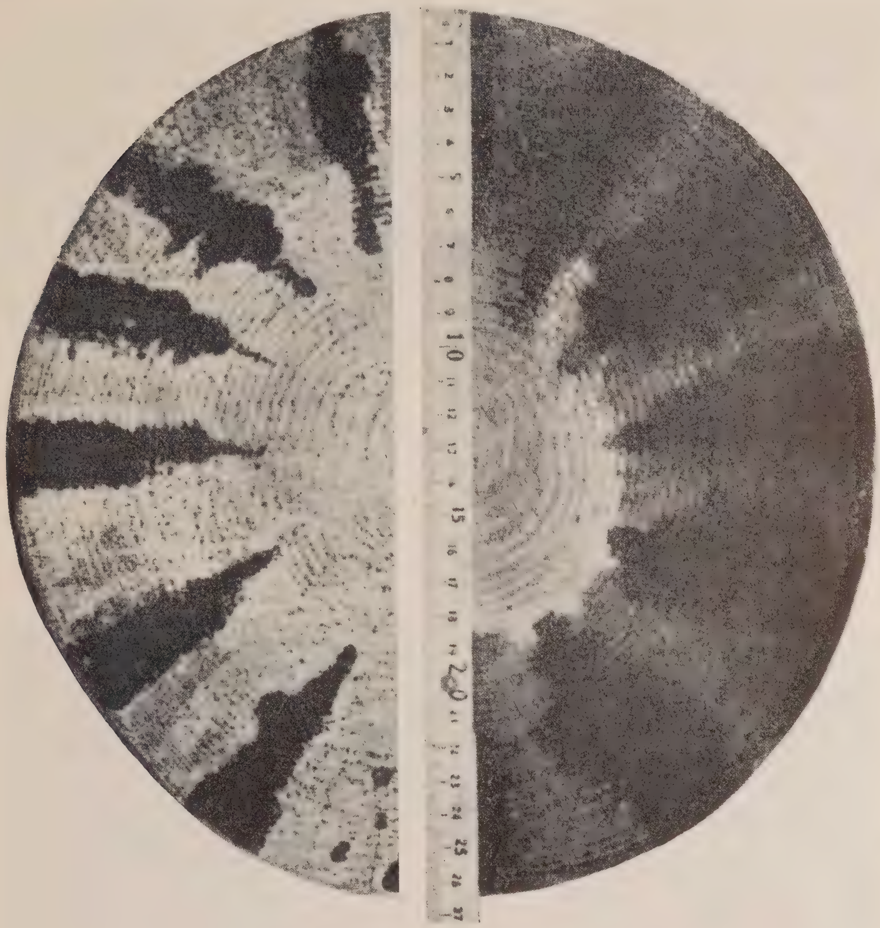
being held downward, is struck into the pole for a depth of 1½ inches, the paste being ejected through the two eyes of the needle by pressing a lever attached to the hammer handle. Stitches are made 3 inches apart, vertically, and 1½ inches apart, horizontally, 18 inches above and 18 inches below the ground line. These perforations are then covered over with the coating of celoyd, described above.

The preservative in this instance,

*The Cobra process, impregnating standing poles.*



*The Cobra process of pole preservation, impregnating hammer.*



*Pine pole after being freshly impregnated by the Cobra process, depth of penetration 60 to 80 mm., or 2½ to 3 inches.*

*Pine pole after standing one year.*

however, is soluble in water and its life in the wood depends largely upon the depth of penetration and quantity of preservative injected.

In 1930, the System had fifty (50) poles treated by the "Cobra" method and to date there remains a fair quantity of the preservative in the wood.

The comparative costs of this method is approximately $2.00 per standing pole, as compared with $4.00 for original installation of protective sleeve; but the replenishment of preservative is 62 cents per pole with the sleeve, as compared with $2.00 per pole with the above process.

Many poles in urban distribution systems are set in locations where the cost of replacement is very high and also, on account of the density of load being handled, the line work construction may be complicated and expensive. The cost of replacement

of such a pole may be several hundred dollars and rarely will it cost less than $60.00. This cost of replacement, if figured at $100.00, say on the basis of the life of a pole being 20 years, figures out at approximately $5.00 per year. If, therefore, the life of the pole with the Toronto Hydro-Electric System protective sleeve is increased only one year it has paid for itself, but there is every reason to feel that the protective sleeve will increase the life of the pole by at least 10 years and possibly 15 years, from which it will be seen that the expensive cost of replacement is put forward that many years and the cost of replacement per year very materially reduced, and, therefore, over a period of years the cost of maintenance of wood pole lines is considerably reduced.

# Fusion Welding

**By W. D. Walcott, Inspecting Engineer, H.E.P.C. Laboratories**

FUSION welding is defined as the process of joining metal parts in the molten or molten and vapour states without the application of mechanical pressure or hammering. The methods most commonly used are:

(a) Oxyacetylene.
(b) Electric Arc.
(c) Atomic Hydrogen.

### Oxyacetylene Method

In this method oxygen and acetylene are stored under pressure in separate containers, and are mixed in a special burner or torch. Depending on the type of work to be done, the torch is adjusted so as to give one of the following flames:

(a) Oxidizing.
(b) Carbonizing.
(c) Neutral.

*Oxidizing flame* is produced when there is an excess of oxygen in the mixture. This flame is used for cutting but produces a weld which is full of non-metallic inclusions.

*Carbonizing flame* is produced when there is an excess of carbon and produces a weld which is hard and brittle.

*Neutral flame* is produced when there are equal parts of acetylene and oxygen, and is the ideal flame for welding.

Acetylene was first produced commercially in 1895 and in the same year in France, Le Chatelier discovered the oxyacetylene flame. The first welding and cutting torches were made in France in 1900, but it was not until 1904 that they were introduced into the United States.

The technique used in the oxyacetylene method is as follows: The flame is played on the surfaces to be welded until the metal is in the molten state. Additional metal in the form of a filler rod is then melted in the flame and is used to fill the space between the two surfaces which are to be welded, and a solid continuous mass is the result when the surfaces are cool.

The oxyacetylene method is used chiefly in welding thin sections, pipe, and non-ferrous metals. Its use for welding heavy structural plates and shapes is somewhat restricted as the intense heat produced is apt to cause warping and distortion. Pre-heating is *sometimes* employed as means of avoiding this, but it is *usually* inconvenient and is always expensive.

### Electric Welding

This type of fusion welding is divided into two main branches:

(a) Carbon Arc.
(b) Metallic Arc.

*Carbon Arc Process*

About the year 1880 Bernadoz and Demeritus, two Russian engineers, experimented with the carbon arc for the purpose of making fusion welds. They carried their work on for several years and in 1887 a patent was granted to Bernadoz at St. Petersburg, now Leningrad.

In this process, heat is produced by an arc passing between a carbon electrode held in the welder's hand, and the work which is connected to the other pole of a direct current supply. The heat from the arc fuses

the parent metal with the filler rod which is melted and is made to fill the space between the parts to be welded. This process is now used chiefly in filling up large holes in steel castings, if strength is not an important feature.

*Metallic Arc Process*

This process was invented by Slavianoff in Russia some time after the carbon arc process had been patented. The earliest record of the process in America was in 1889 when Coffin of Detroit was granted a patent covering the use of a metallic electrode.

In this process an arc is drawn between the metallic electrode and the material to be welded usually called the parent metal. The electrode is melted and provides the necessary material for filling the gap.

From the year 1889 up to about 1910 comparatively little progress was made in welding in America, and it was not until during the Great War that welding received the impetus which gave it the prominence it enjoys to-day as an effective method of fabricating and repairing. At that time it was found necessary to make extensive repairs to the machinery of several German ships interned in U.S. ports. Since it was thought that welding could be used to advantage in this work, a special committee composed of eminent engineers and scientists was formed and was known as the Welding Committee of the Emergency Fleet Corporation. They supervised the repairs to these ships which were soon put back into commission. After the war, the American Welding Society was formed by some of the prominent members of this committee who did not wish to drop their interest in welding, and since that date great advances have been made in the art. Improvements have been made in welding equipment and in technique. Electrodes have been produced which are suitable for nearly every variety of metal, ferrous and non-ferrous.

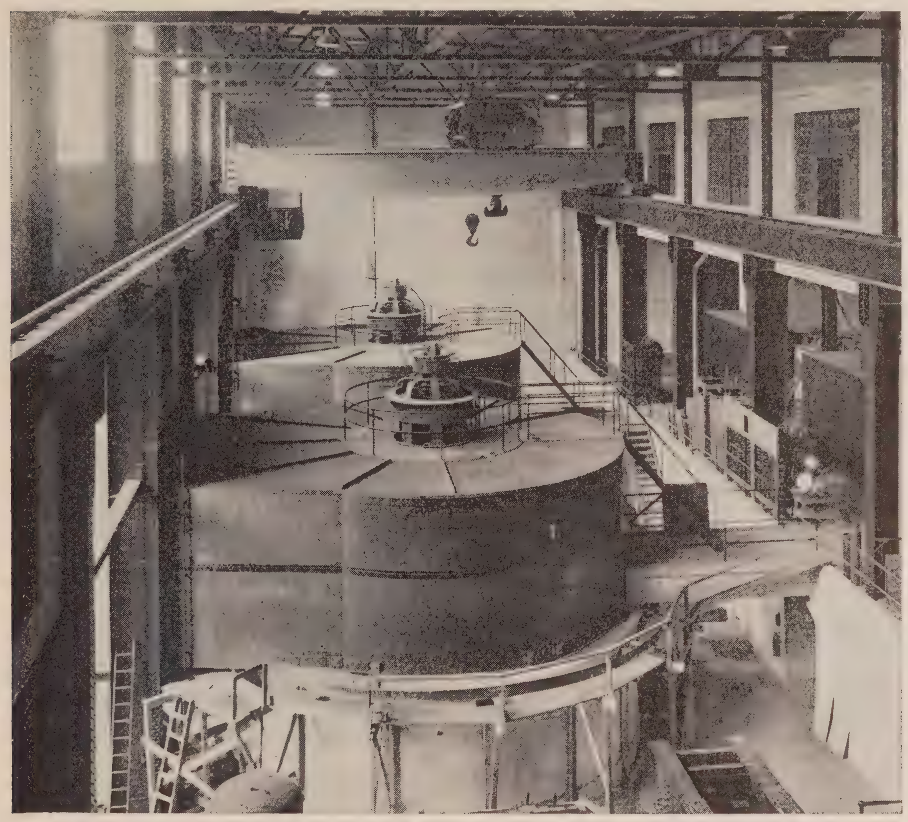
Steel electrodes may be divided into three main classes:

(1) Bare.
(2) Coated.
(3) Covered.

The bare electrode produces a weld which gives a tensile strength of about 55,000 to 60,000 lb. per sq. in. It is, however, brittle and gives low results in elongation. Its value in impact is low and it is not very resistant to corrosion. Its lack of ductility and low corrosion resistance are due to the absorption of oxides and nitrides from the air during the process of welding. The oxides form scale and the nitrides take the form of long needle-like crystals which are visible under a magnification of about 500 diameters. This class of rod should only be used on relatively unimportant work.

The coated electrodes are produced by dipping the bare electrode in a wash of lime or asbestos. This forms a thin coating over the rod and affords slight amount of protection to the arc. The physical characteristics of welds made with this type of rod are a little better than those made with the bare rod, but they show the same lack of ductility and give low values in impact and corrosion resistance.

The covered rod has only been introduced comparatively recently. As



*Generators of welded construction in the Abitibi powerhouse.*

its name implies, the rod is completely covered with a thick coating made with one of the three following bases: (a) Wood flour, (b) Cotton yarn, (c) Asbestos fibre. Certain chemicals are added to these so as to form a reducing atmosphere when the coating is burnt after the arc is struck. This reducing atmosphere prevents the absorption of oxides and nitrides into the weld metal and produces a weld which is strong and ductile with good impact values and resistance to corrosion. This method is sometimes called the "shielded arc process" and is now extensively used in fabricating boilers, high pressure and high temperature vessels for the oil-refining industry, tanks, large generator rotors, penstocks, pipe lines, buildings, bridges, and other important structures. The "shielded arc process" is looked upon as the greatest advance in welding in the last ten years.

### Atomic Hydrogen

This method of welding is a combination of both gas and electric arc methods and was invented comparatively recently in the laboratories of the General Electric Company by Dr. Langmuir. A jet of hydrogen is projected through an arc between

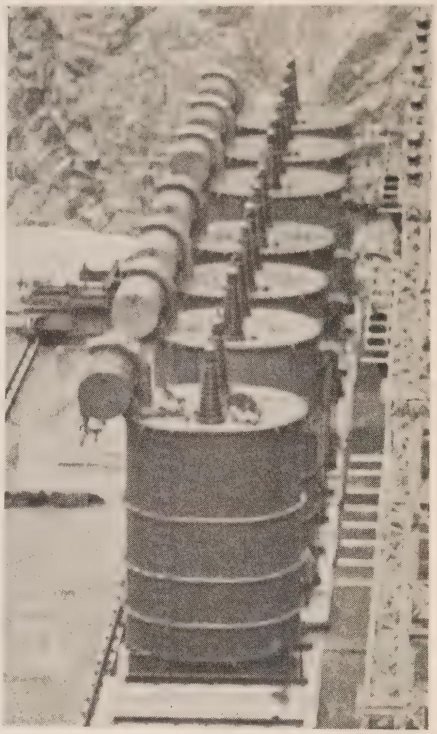
two tungsten electrodes. The high temperature of the arc breaks down the hydrogen into atoms which, after passing the arc, recombine into molecules and give up the heat absorbed during dissociation. During the deposition of the weld, the sheath of hydrogen excludes the air and prevents the formation of oxides and nitrides which are harmful to the quality of the weld. The temperature of the flame produced is higher than that of any other flame.

On account of the cost and the high temperature of the flame, the field of atomic hydrogen welding is rather limited and it is best adapted to thin sections. A weld of the highest strength, density, and ductility is produced. It can be used in welding steel with a carbon content as high as 1.25 per cent. It is used in making joints on mercury arc rectifiers and similar vessels where high pressure prevails and where absolute tightness is necessary. Recently, it has found extensive use in making joints in household refrigerators.

### Conclusion

In the earlier days, welding was used chiefly as a method of repair. The last ten years have produced rapid advances in the art of welding, and it is now extensively used as a means of fabrication.

Welding has supplanted riveting to a large extent and it is generally admitted that any structure which can be riveted can be welded quite as satisfactorily and, in the case of joints, higher efficiencies can be developed by welding than can be obtained by riveting.



*Abitibi transformers, electrically welded.*

In order to obtain the best results, proper supervision and efficient inspection should be maintained, and the second part of this article will deal with the more important considerations of these features.

# Progress in Light Sources

**By Samuel G. Hibben, Director of Applied Lighting, Westinghouse Lamp Company, Bloomfield, N.J.**

(*From a talk given before The Electric Club of Toronto, December 13, 1933.*)

WE wonder sometimes where to start a discussion of this broad subject of light. The first thing with which the ordinary individual may be concerned is the ordinary "light" we see about us, and we usually have very little thought even for that. It is only lately—during the last three or four years—that man has begun to realize that not only do we need light for seeing purposes, for visual photography, if you will, but we are going to need and are coming to use luminous sources for other than aids to human vision.

Thinking first of visual operations, and of the lessened working hours of wage-earners, we must see better, for both work and play. We live on the average about 60 years, according to the Life Insurance Companies, but during those 60 years a man will sleep away 20 years of his allotted span. He will eat and read and play and otherwise divert himself for 25 of his allotted 60 years, and he has thus consumed 45 years exclusive of productive labour hours. He actually works only 15 years at best, so the 15 working years are all we have at our disposal. If we do not create enough wealth in those 15 working years, so we may sleep dreamlessly for 20 years or play happily for 25 years, we have not accomplished much — at least, not with a surplus for our dependents—and if we do not have all the tools with which to work efficiently in those 15 years, we fall short of achieving what we are destined to achieve.

So light as a tool becomes an important part of man's working material, as well for waking as for sleeping hours.

Then too, in summarizing the reasons why we are interested in light and radiation, we recall the fact that they are the means of securing knowledge in a vast degree.

We can learn through the sense of taste only about 1 per cent. of our complete knowledge of surroundings. We can smell, or learn through the nose, at best, about 3½ per cent. We learn through the sense of touch to the extent of 1½ per cent. Our knowledge through the auditory nerves, or by hearing, constitutes about 7 per cent. of our total, leaving to the sense of vision or to the eye the responsibility for some 87 per cent. of all our knowledge. In other words, if our eye under a proper light does not easily function, it makes a vast difference in the busy avenue by which messages from outside can reach the human brain.

Then consider the range or reach of the senses. A taste requires contact. Smell—well, if the wind happens to be blowing from the stockyards in our direction, perhaps we can smell a distance of five miles. My range of knowledge is very limited through the ear—20 or 25 miles, or to be generous, 50 miles at the

outside is about the limiting radius of hearing. But the eye—ah, I will leave it to you—its reach is 300,000,000 light years, if you will. Almost all that we hope to learn of the surrounding space is through the eye. The reach of vision is almost limitless!

I am not at all exaggerating when I say we must consider the use of radiations and of the eye, to be the main thing of interest in civilization today, for the advancement of learning or in building up and bettering the methods of living.

### Gaseous Lamps Mere Infants

It is interesting, too, to think about the fact that in the 300,000 years or more of man's existence in human form on this planet, we have seen but poorly. After sunset we yet see poorly! We have had useful kinds of artificial lamps for some such time as 3,000 years. Portable lighting devices are only about that ancient. Farther back than that, it was a matter of the fagot or the bonfire, if anything at all. We have had the incandescent metal filament lamp only a matter of about 30 years. The first incandescent lamp for exterior decorations at the World's Fair in Chicago appeared about 40 years ago. The filamentless or gaseous conductor lamps we have had a matter of three years, so we have not had modern illuminants freely at our disposal for any considerable time. Good use of radiant energy is young!

One more point of preliminary information, before I come to the pertinent parts of the subject. We are interested in efficiency and I am going to give you our efficiencies in lumens per watt of consumption, because these data constitute milestones of progress.

| Date Available | Type of Source | Amount of light per unit energy used |
|---|---|---|
| 1879 | Early filament lamp | 1.4 |
| 1893 | Carbonized filament lamp | 3.3 |
| 1905 | Metalized filament (carbon) | 4.0 |
| 1906 | Tantalum metal filament | 4.8 |
| 1907 | Squirted tungsten filament | 7.9 |
| 1911 | Drawn tungsten wire | 10.0 |
| 1913 | Inert gas-filled lamp | 12.6 |
| 1926 | Mazda (inside frosted) lamp | 13.2 |
| | Best Mazda (projector type) | 25.0 |
| | High Pressure Mercury | 40.0 |
| | Sodium Vapor lamps | 50.0 |
| | Solar Disc (at 6000 deg. C.) | 80.0 |

This brings up the question of lamp life and efficiency in so far as it affects our pocket-book, because lighting is, after all, still a pocket-book problem. We want to get the most light for the least money. I have heard it expressed many times that "lamps do not last as long as they used to do." In many instances they do not. In many services they absolutely should not! If one wants an inefficient, long-life lamp, he can have it, but if he wants a modern, efficient medium-lived one, so be it. If one wants a very high efficiency short-life lamp, he may have that too.

I have in this box as examples a series of lamps, all consuming the same amount of power — 60-watt lamps, but differing only in the matter of life and efficiency.

### Lamp That Burns 1,000 Years

The first lamp will, barring mechanical breakage, have a life of

*Replica of "Stopper" lamp used to light World's Fair of 1893 in Chicago.*

1,000 years. That is its "rated" life, but it emits no light. Do you want that lamp in your home? I don't think you do, even though it "lasts a long time."

The next lamp will live 18,000 hours, producing a little light, but with a shorter life. Next, we have a lamp that will burn 5,000 hours, still somewhat brighter, but not bright enough. The 1,000-hour lamp next in line is practically the lamp of commerce today. If you saw only the 1,000-hour lamp you would say it is fine. It gives a good bright light, of reasonably white colour, with a fair average life. Still, it may not be the best design because if I were willing to sacrifice a little life and use the 750-hour lamp (next shown), I would get still more light. A 50-hour lamp may sometimes be good if I am only going to use my cellar light for a short time a week, or do occasional fine work like sewing or engraving. If I chose to take photos or wanted a great deal of light with little need for life, I would burn a 5-hour lamp. It emits 1,870 lumens, compared to 740 lumens from the 1,000-hour lamps.

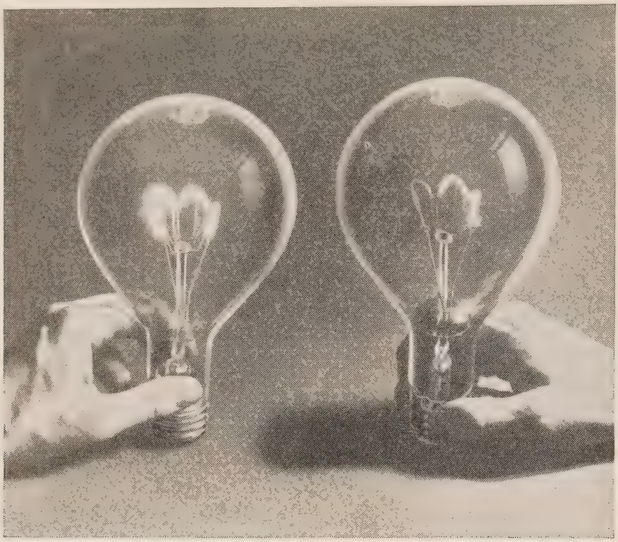
Thus we have the two extremes—5 hours, to many, many years. The range of filament lamps is interesting, since as we increase efficiency, we have a shorter lived lamp but we gain tremendously in usable light. The cheapest lamp is that one which produces its light the cheapest; not the one which merely lasts a long time.

These various lives have gone in extreme directions. For instance, the long life lamp we would use for an infra-red or heater lamp, with possibly a life of many years if continually burned, but designed to produce heat, and not visible radiation. Its uses seem destined to multiply rapidly.

### Lamp That Burns 1/100 Second

At the other extreme is the lamp whose light is emitted for less than 1/100 of a second. It is the common photo-flash lamp in which we have a certain amount of oxygen and aluminum foil, so that it burns almost instantly, emitting more than four millions of lumens in a fraction of a second. We can take pictures without such a discomforting flash if we add the specially coloured bulb. Such a lamp is used to take pictures of animals, sports events or court-room scenes, or wherever glare is to be minimized, without sacrificing the actinic value so necessary to good photographic results.

The Mazda Photoflood lamp for taking motion pictures, of approximately one hour's life, is a very efficient photography and emergency



*Three-light lamps which have three different wattages.*

service lamp. Another recent addition is the long tubular lamp of filament type used in the Century of Progress Street Lamps in Chicago. We have evolved and are now finding very considerable sale for lamps with 2 filaments of different candle-powers within the same bulb named the "three-light" lamps. These have a double contact base, so that one may have a 200-watt lamp or a 300-watt lamp, or by burning both filaments a 500-watt lamp, giving us greater flexibility in illuminating our stores and shops.

Sealing of the lead wires or connections to a lamp bulb in the form of a sphere so as to resist crushing, and developing a self-sealing and tight connection so the lamps can be used under water, provides us a submarine or diving lamp useful beneath the surface of the ocean. It took about three years to find out how not to make such lamps. One would try to seal wires inside of a pipe with suitable materials to resist high pressure, but that proved exactly the wrong way to do it. The only way to effect tight joints is to wrap the wires loosely with certain rubber tape and let the pressure of the water seal it. About 100 or 300 feet down, the pressure of the water is so great that the rubber tape is moulded into a solid block and sealed.

I was very much interested in working with Dr. Beebe, who has gone down 1,000 feet in the ocean for the observation of fish and marine phenomena. There the divers' lamps are used as lures; as you drop the light down to the dark strata the fish may follow it up to the surface of the water, and in that way they are studied.

The manufacture of special lamps for the lighting of caves, of paintings, of battleships, for the growing of

plants, and a thousand other purposes might be mentioned.

Manufacture of any particular article began by copying existing types of articles. Horseless carriages became automobiles. Lighting fixtures were first candle holders, then chandeliers. From the time of the French Louis' until today we have had chandeliers but few electroliers. We burned kerosene and then had lighting fixtures to imitate the kerosene lamp. Lately, we have had a new idea. The old package has become obsolete and the old method of advertising has taken on a new aspect. So with lighting material. New lamps and new bulb shapes call for new luminaires. New methods of lighting bring colour prominently into the picture.

Many of you could possibly describe better than I can how it is that we can get light without really going through the medium of heat, or by heating up a metal and causing it to glow, as we do in a tungsten filament lamp.

We recall to mind the fact that whether we consider light as a series of waves of projection, or as quanta, like shots, we have thought of the ordinary atom of the molecule in the element as consisting of a nucleus of a positive charge of electrical energy or "proton" and a series of rotating "planets" of negative charges around the centre as in the solar system. The orbits have various radii, these negative charges balancing the positive charges. What we are now trying to do is to dislodge these negative charges out of their orbits, for the purpose of man's lighting need—out of their respective paths around the nucleus. If we change the radius of a negative charge moving around its nucleus, then allow it to fall back to its old orbit, there will be a giving up or freeing of the energy put into it, and that freed energy may appear as luminous energy or visible radiation. When we say we "ionize" a certain atom, we simply mean we dislocate a charge or electron out of a certain path of revolution.

### Gases That Glow

We first look to nature. Most scientific research starts with observing Nature's wonders anyway. In the higher latitudes, on such nights as we have in winter, of sudden temperature change, we may find ionization of the gases of the atmosphere and those gases become luminous under the influence of the earth's polar electrical field. We call this the aurora borealis. Crypton, Xenon, Argon, Nitrogen, gases we try to capture in tubes, are possible illuminants. Everybody is familiar with the glass tubing used with neon gas. We ionize neon by bombarding the gas atoms with a stream of electrons in the tube, and there results the orange-yellow glow. These gases have broken line spectra like a picket fence. Each gas has its especial spectrum, or composite colour.

Most of our tubing in outdoor signs contain neon (orange) or mercury (blue) or helium (cream). They consume on the order of 10 watts per foot of tube, and require high voltage to start. From these tubes we do not get much light, say 3 or 4 lumens per watt, compared to 20 from filament lamps, so the ordinary sign tubing is not so good as an

illuminant *per se*. One can increase the pressure of the gas, as is being done now in metallic vapour, and get 30 or 40 lumens per watt. Heat the electrode or cathode and thus increase the storm or flow of electrons from such, and we increase the output of light.

Included in the hot cathode type of vapour lamps are neon, mercury, zinc, sodium and several others. Some of these are put in the form of a bulb rather than in the form of a tube. The mercury lamp I have here illustrates a hot cathode type of vapour unit in a bulb. It gives us a blue spectrum. We have limited the current flow, and by putting our electrodes within a bulb instead of a tube we may achieve more convenient shapes for reflectors.

Mercury vapour may show short-wave radiation, too short to be seen by the human eye and popularly termed the ultraviolet. We could spend all evening discussing what ultraviolet can be used for by our children. It is now used to increase the lime and phosphorous content of the blood and so improving the condition of the bones, teeth, finger nails. But that is only the beginning.

If we want to use it as a body treatment, it will tan the skin and aid in curing certain diseases, chiefly of the outer surfaces. If we want to develop ozone in the air, to purify or sterilize, then this also may be done.

### Branding With Ultraviolet

Extremely short waves, from special lamp types, will produce tan or sunburn in two or three minutes. In the case of a criminal or convict we will just tan a large letter on his forehead and it will not rub off nor fade for six months to a year. After

*At Port Jervis, N.Y., is the first ornamental street lighting installation of sodium vapor lamps in the world*

*A "Black Bulb" gives a good photographic light.*

that, he can appear in good society, but the mark cannot be prematurely erased. Or a new born baby in a hospital, if you want to be sure of his identification, can just be turned over on his stomach and painlessly branded. Short wave ultraviolet can speed up the tanning of leather, aid in the detection of oils in sewage, the testing of pigments as against sun-fading, and the fastness of dyes—useful in a hundred different ways.

In the production of "Black Light" we use the hot cathode type of lamps producing mercury spectra. Practically the only "light" escaping will be of the short-wave length invisible to the human eye, but visible if photographed.

I really feel that as lighting science goes on, we are opening out into so many enlarging fields, we cannot even see the horizon nor anything but the immediate foreground. We see, even with our greatest imagination, no end in sight in the development of illuminants, and we seem to be standing at the misty dawn of a truly great day in lighting research.

# A Cable in the Arctic

**By G. B. Fuller**

SOMEWHERE in the frozen wastes of the Canadian North West Territory—on the shores of the Great Slave Lake—an Indian of the Dog-rib tribe may at this moment be backing a fishing net below the ice with a piece of cotton-covered and waxed telephone cable; he may be using a length of it to snare a marten; or he may be showing it proudly in his wigwam as a souvenir of the visit of the six white men who came from England to photograph the Northern Lights.

These odd pieces of Henley cable are, perhaps, the only souvenirs left behind by the expedition which sailed from England in May, 1932, under the leadership of Mr. J. M. Stagg, of the Meteorological Office, to make a scientific study of the variations of the earth's magnetic field and endeavour to determine the position in space of the associated aurora by parallactic photographic media.

The expedition is back in England again; back after achieving distinct success and after accomplishing what probably had never before been accomplished in one winter's photographic work in Arctic wastes. I met Mr. Stagg again early in November—a few days after his return from the barren wastes of the region around the Great Slave Lake, where large tracts of country are yet unsurveyed. He told me that the eighteen months had passed very quickly: "There was so much to do," he said. Adventure? Yes, they had experienced scraps of adventure and difficulty. A long hut containing the wireless equipment blew up, but no one was hurt. Stray "huskies"—sleigh dogs—chewed the insulation of the cable as a change of diet. Photographic paper became so brittle in the dry atmosphere that it could not be handled without risk of cracking and spoiling. Meteorological balloons would decide to burst at awkward times and heights, necessitating further manufacture of hydrogen gas in difficult conditions. There were the painful first experiences of frost-bite, too. But Mr. Stagg smiled as he told it all to me—just accepting the difficulties as part of the job. "We got our first equipment set up," he said, "and hunted for a means of erecting the cable between our two stations—16 miles apart. We hoped to make use of the stunted spruce trees at the side of the lake for suspension, but the shore line was so indented and swampy that we decided that it was a job for a Company of Royal Engineers rather than for a party of novices, too full of observational duties. We were using two wireless sets, which we took with us to cover such contingencies until the lake froze in late October. Immediately the ice covering was thick enough to allow us to work we felled a large number of spruce and birch trees about six to eight feet tall and cut holes in the ice at distances of 100 yards. Then, with the cable threaded through insulators loosely tied to the poles, we stuck the poles in the holes in the ice. By next morning they were sufficiently frozen to allow us to put enough tension on the cable

*(Left)—In the bush the cable was simply tied to the largest spruce trees, bared down one side.*

*(Right)—At the edge of the bush, where the desolation of the snow wastes begins. From here onwards the cable was tied to poles let into the frozen lake surface.*

to raise it to a minimum of five feet from the surface of the lake."

In the early stages there were but few difficulties in manipulating the cable, but when the cold registered below zero it was inclined to become brittle, and ultra-careful handling was necessary to keep it from snapping.

"Erecting the cable in the cold was a brute of a job," Mr. Stagg said emphatically, "and at one time we thought that the sleeve coupling for binding the two ends of the broken cable together would run out when tension was put on to the cable."

At first, to prevent the cable slipping back through the insulators after tension had been put on, they bound the cable to the insulators with thin copper wire, but they found later that the wire had cut though the cotton and wax insulation and was biting into the core itself, so that the winds across the exposed lake surface, combined with the brittleness of the cable, caused further breaks. So instead of wire binding they used stout twine.

At each end of the line, where the cable was taken through the bush, spruce trees were bared to a certain height and the cable was simply tied to the trees. Altogether, the task of laying approximately sixteen miles of cable took the party, mainly working with three men and in the short days of early November, only ten days.

I asked Mr. Stagg how the cable stood up to the severe conditions. "At first," he said, "signals were weak. For earth we had used copper mats buried outside the log shack in very shallow earth, but after a little experimenting we found that an extension of the earth line out to the lake and down through the ice into the residual unfrozen water would give more efficiency by providing fresh water return. The efficiency

of the signals was increased many times. Indeed, for intensity and clarity of signals the telephone line along sixteen miles of lake and bush worked as efficiently as an ordinary telephone line here at home."

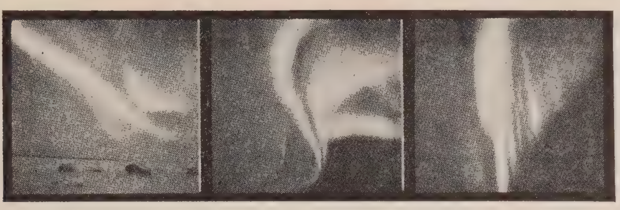
During the winter, as the ice covering on the lake thickened from a few inches to five or six feet, the earth poles became embedded in ice instead of water, and the intensity of the signals naturally decreased; but by cutting fresh ice holes in a deeper part of the lake the water return was maintained throughout the winter.

"For the greater part of the time, the telephone line caused but little trouble," Mr. Stagg said, "but once, after high winds, some of the bindings between the cable and insulators on posts in the lake were broken so that the line sagged down near the lake surface. This may have been due to the insulators themselves becoming friable through the intense cold. Another difficulty we had was with Indian dog-sleighs, which could not notice the cable crossing the lake. While following the trail they often severed the cable. This, of course, meant a little repair expedition with our own dog-sleighs."

Mr. Stagg told me that their first frost-bite was experienced during the erecting of the cable. "At that early stage we had not been sufficiently aware of the precautions necessary when working out-of-doors in high wind and low temperatures," he admitted, "but later we found how it was possible to do most repair and adjustment work without baring the fingers, and no serious consequences resulted."

He said that the party secured over 4,500 double pictures, giving at least that number of measurements of height of aurora—probably the largest number that has ever been taken in one winter. Emphasizing this, he said, "In the photographic part of our work there was probably no more useful or important part of our equipment than the telephone line connecting our two stations. Without it, we should not have been able to get as many double photo-

*Auroral shelter and camera at the sub-station, connected by telephone with main base some 15 miles to the N.W.*



*Types of auroral display showing curtains, ray bands and streamers.*

graphs of the aurora from the two ends of our base line as we did."

Bully beef, camouflaged by a clever cook, was one of the staple items on the menu of the expedition, whose main station was at a trading outpost of the Hudson Bay Company at Fort Rae, where at times large numbers of Indians of the Dog-rib tribe collected for barter, bringing in their fox, marten, mink, musquash and other fine grade pelts in exchange for ammunition, clothing, flour, tobacco and similar necessaries.

With the vivid mental picture painted by Mr. Stagg still in my mind, I cannot understand the man who tells me that there is no room for emotion in modern life. He may be right, but to prove it to me will need some substantial fact. Mr. Stagg is a Scot, without any apparent emotionalism in his make-up, but he finished up his story by telling me how, as soon as the cable was abandoned at the conclusion of the expendition, there was a general rush of Indians to obtain what pieces they could, both as souvenirs and for backing their fishing nets below the ice surface of the lake in winter. And his concluding words were these: "To those of our party who had expended so much energy in erecting the cable, it was pathetic in spring this year to watch the stages of disintegration—the posts loosening in the ice, the sinking of the line, and gradually the complete disappearance of the cable upon which we had so long relied."—*Distribution of Electricity.*

# Are Your Ladders Dependable?

**By F. L. Hurlbutt, Manager, Patent Scaffolding Company, Chicago, Ill.**

*Safety in the use of ladders requires careful attention to all details of selection maintenance and use.*

LADDERS in one form or other have been used by mankind since the beginning of civilization. Everyone uses ladders. They are such simple tools and look so harmless, that the countless accidents resulting from their use come from "familiarity breeding contempt."

Unlike most of man's tools, ordinary ladders of to-day are essentially like those used hundreds of years ago. The same material, wood, is used in their construction, whereas we might well expect to have our modern ladders of a light metal, such as aluminium, with the rungs welded to the rails.

In discussing ladder accidents, let us divide our subject under three headings:

1. Selection.
2. Care and Maintenance.
3. Proper Use.

By "selection" I mean the purchase of equipment. I can think of no piece of plant equipment in which there is the opportunity to buy either safety or accidents that there is in ladders. Good ladders cost more initially, but they certainly justify their price, both because they are safer and last longer. (Note: Ladders used by the Hydro-Electric Power Commission are all bought to a specification).

In all the field of ladders there is no greater accident producer than the cheap stepladder, and yet thousands are sold. To those of you interested in step ladders for industrial use, buy only the best or you will certainly have accidents.

Any stepladder for industrial use should have side rails of a thickness of at least seven-eighths of an inch and preferably an inch, by three and a quarter inches. The steps or treads, to give a good footing, should be not less than three and three-quarter inches wide. Steps should be truss-rodded or braced to the side rails with angle braces. Frequently, it is necessary for a helper to assist a worker from the back of the ladder. For this reason the rung-back type of stepladder is preferable for plant use, as it is decidedly stronger than the slat type back and will not become wobbly. Personally, I would not have a slat-back type ladder in a plant. The spreader is a fertile source of hand injuries. These can be entirely eliminated by the use of safety spreaders which have a shield over the joint to protect the hands.

The greatest contribution to safety in stepladders was the introduction a few years ago of the platform stepladder. With this ladder, the worker stands on a solid platform guarded on three sides by the side rails and the top member. If he has occasion to reach outward in his work, he can brace himself by pressure of his knees against the side rails and by

the front of his legs against the top member. The gain in efficiency and safety for the worker when using a platform stepladder in contrast to and ordinary stepladder is so great, that it seems only a matter of time before it will completely replace the ordinary type for plant use.

Another type of ladder frequently used for maintenance work is the extension trestle. This ladder is of the "A" type, having a center section which slides up and down. These are generally used in pairs with a stage between them, or in sets of four with two stages, and with planks from stage to stage. In selecting extension trestles, the principal points to look for are adequate length guides, and strong locks for the sliding section, and a safety spreader.

Time will not permit going into the many other types of ladders such as sectional ladders, window cleaners' ladders, fire ladders, etc. Suffice it to say that the same rules govern their selection as in the case of the types already discussed.

We now come to the part that care and maintenance of ladders play in the accident prevention campaign. I think I can say without fear of contradiction that most structural failures in ladders occur as a result of misuse in handling and storing, rather than from the actual strains imposed by the workman. Ladders are dropped carelessly in handling, slide off piles or trucks, often resulting in cracks in the front or back legs. Frequently, ladders are stored horizontally with supporting points near the ends, resulting in sagging, which may put a permanent set in the ladder, thereby lessening the strength of the rails. Ladders should always have several supporting points when piled horizontally to avoid this possibility. Ladders should be stored in a place which is protected from the weather. Water and dampness will cause the wood to check and rot the rung tenons. This latter damage is difficult to detect.

To offset the effect of moisture, it is recommended that ladders for outdoor use be given first a coat of linseed oil and then a coat of colourless shellac. Do not paint ladders, as it is then difficult to detect knots or checking.

A regular inspection of ladders is strongly recommended to prevent unsafe ladders from getting back into service. All workmen should be told to return to their foreman any damaged ladder instead of putting it back where they got it for someone else to be injured on. If the damaged ladder is beyond repair, the foreman should immediately break it up so it cannot be used. If it is to be repaired, it should be conspicuously tagged, "Not to be used while this tag is on this ladder."

When there is doubt about the strength of a ladder, even after an inspection, a test should be made. Support the ladder horizontally at points about six inches from each end, and apply a load of two hundred pounds at the centre. For varying length ladders the permissible deflection increases with the length of the ladder. If the ladder under test exceeds the permissible deflection, it should be discarded or cut down to a length at which it will conform to the code. Frequently, an inspection shows a wobble or shake in a

ladder which can be eliminated by tightening up the tie rods.

In short, if the maintenance department would give the same inspection and care to ladder equipment that they do other plant equipment, many unnecessary ladder accidents would be avoided.

The third part of this article relates to "proper use" of ladders. It might be entitled "misuse" or "abuse" for misuse is the cause of a very large proportion of the serious ladder accidents. Regardless of having good ladders, in spite of faithful inspection, if a ladder is not suited to a job, an accident may occur. Frequently, an extension ladder is a little too short, so someone forgets that there must be a proper lap of the sections and does the job or tries to. If he gets by, he is lucky, for he has imposed a strain on the ladder for which it was never designed. Extension ladders up to 36 feet should have a minimum lap of three feet; ladders 40 to 44 feet require a lap of four feet; 46 to 50 feet take five feet, and over 50 feet, six feet must be had.

Take the case of the steamfitter, standing on a stepladder and using a large stilson wrench. His ladder may be a good one, but was it ever intended to take the load he is subjecting it to? Probably he should be working from a scaffold, not a stepladder. The pressure he is exerting upward on the wrench plus his own weight is enormous.

Numerous accidents occur from placing ladders at incorrect angles against walls. If the ladder is placed so that it is too close to the wall at the bottom, there is the danger of overbalancing when the user ascends; while if it is too far from the wall at the bottom, there is altogether too much bending strain in the side rails. A good rule of thumb to prevent such accidents is to keep the horizontal distance from the wall to the ladder at the bottom one-fourth of the length of the ladder.

When ladders are being used where people or moving objects are passing by, a helper should always be stationed at the bottom of the ladder. Non-slip treads will not take care of this situation.

### Slippery Surfaces

Slippery surfaces present a problem when ladders are to be used. Under such conditions, the proper type of safety ladder feet must be used. Ladder feet are of three general types: (a) Those having an abrasive metal surface; (b) those with cork soles or rubber suction soles; and (c) those having spiked points. The various conditions that must be met, requiring some form of safety feet, are so numerous that it is impossible to lay down any hard and fast rule as to what type feet should be used. In general, on smooth surfaces the cork or rubber suction type is best. Yet, again, on wet or oily concrete surfaces, the abrasive metal type will probably have to be selected. On wood or hard ground, the steel point is superior.

When ladders are used against shafting or pipes, if conditions permit, it is desirable to equip the ladders with hooks which will go over the shafting or pipes. In using long ladders out-of-doors against buildings where the ground condition is not

too good, the safest thing to do is to lash the ladders at the top. There is always a tendency for a man using a long ladder to try to reach as far as he can either side of the ladder to avoid climbing down and moving it, and it is this reaching that makes lashing desirable.—*National Safety News.*

## Jim McGraw

His many friends throughout Ontario, from Niagara Falls in the south to the head of the Great Lakes where he was almost equally as well known, will be deeply grieved to learn of the death of Jim McGraw on Monday, January 15th.

Forty-five years ago, at the age of eighteen, he began work with the Niagara Falls Power Company, and ever since that time has been identified with water power construction, both in the United States and Ontario, working practically up to the day of his death. Coming into the employment of the Commission when the construction of the third pipe line for the Ontario Power Company plant was begun in November, 1917, he remained with us as General Superintendent of Construction until November, 1923, when the insistent call of his former employers and the low ebb of construction activities here, induced him to sever his connection with us. His nature was such that he could ill brook even comparative inactivity. But in all these years he never lost touch with his friends in the Commission or his interest in its doings, and in 1930, during the building of the Alexander Development, he came from Buffalo to pay a flying visit to his old haunts on the Nipigon River and offer his advice on the construction problems presented there.

Respected as he was by all who came in contact with him for his wide knowledge and his ability to call the best out of men in their own particular sphere, far deeper feelings are held towards him by those who were privileged to know him more intimately; who recall the interest and the unfailing, generous help which he always extended to those younger members of the staff whom he was trying to bring on in their chosen field, and who can remember his unobtrusive but complete and confident domination of any emergency. His passing will leave a void in many hearts, but the memories of him will always be pleasant ones.


SALES DEPARTMENT

HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


## A Review of Some 1933 Features of the Hydro Undertaking

**By The Honourable J. R. Cooke, Chairman, Hydro-Electric Power Commission of Ontario**

*(Address to the Electric Club of Toronto, the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities at Toronto, January 31, 1934).*

THE subject of hydro-electric power and of the progress of the electrical utilities that exist for the purpose of assuring to the citizens and industries of Ontario ample supplies of electrical energy at minimum cost consistent with sound financial procedure and high quality of service, is a subject in which all here present have a vital interest, whether individually we are connected specifically with administration of utilities, with technical phases of the work, or with the manufacturing or merchandising of electrical equipment and appliances.

You will concede that it would be a waste of effort to manufacture and offer for sale electrical equipment and appliances, if the electrical utilities were not faithfully carrying out their task of providing for the prospective owners of such equipment the necessary electrical energy for its economical operation. Correspondingly, it would be useless for the Hydro-Electric Power Commission of Ontario and the municipal electrical utilities to provide supplies of electrical energy for the use of the citizens, if the electrical manufacturers and dealers were not ready to supply the consumers with the means of utilizing the energy, and ready also to supply the utilities themselves with the equipment required in carrying out their functions.

In a word, we are all—each in his own field—striving towards a common objective of enabling electrical power and energy to contribute the utmost of benefit of which it is capable, to the economic and social welfare of our citizens, and, therefore, each department of activities has an intimate concern in the progress of the others. In reviewing very briefly

## CONTENTS

**Vol. XXI No. 2**

**FEBRUARY, 1934**



some of the outstanding features of Hydro experience during 1933, and, perhaps touching upon certain matters of special interest, it is a gratification to us, I am sure, to note the evidence afforded that the Hydro enterprise, in passing through a period of economic severity, has not only maintained a sound position, but can even record substantial advancement in important directions.

You are busy men, more or less absorbed with the demands of your special work, and have relatively little time to follow the problems of others. It has occurred to me, however, that there are aspects of some of the problems of our Commission's work that may be of special interest to you, and so I am going to commence by drawing one or two of these to your attention.

As you know, owing to world economic conditions we have been confronted with problems arising out of international exchange.

### Retirement of Certain Capital Obligations Involving Considerations of Exchange

Those who have been in contact with, or even who have been observing, economic conditions prevailing since 1929 are aware of the fact that nations, as well as individuals, have experienced special difficulties arising out of problems in international finance. The factors in some of these problems quickly assumed an importance beyond what might have been expected from previous experience. Consequently, the great banking institutions of the world found themselves severely taxed to steady prevailing conditions and there was little, if anything, by way of definite counsel offered as a guide to the perplexing problems that faced other organizations as well as private interests with financial obligations to meet.

In a word, the prevailing conditions were such that each concern was more or less thrown upon its own resources of experience and judgment to meet existing conditions and to provide as best it could for the obligations of the early future.

The Hydro-Electric Power Commission of Ontario was not free from perplexing difficulties arising from questions of international exchange, and from the need to provide for the retirement of bonded indebtedness. Various criticisms were levelled at the Commission because of additional payments it had to make due to the unfavourable exchange against Canadian funds in terms of United States currency. Throughout the period that the very unfavourable exchange prevailed, the Commission day by day watched the market circumstances and availed itself of every favourable opportunity to minimize exchange expense.

The Commission takes no special credit to itself, knowing that it has simply performed its duty in watching

the situations, in exercising its best judgment and in taking prompt action where it seemed that advantages upon behalf of the co-operating municipalities could be obtained.

Recently, there occurred two situations in which the Commission was able to effect substantial savings and it is believed that a brief description of these incidents will be of interest. They show in part the character of some of the problems which confront the Commission, and are indicative also of the procedure that the Commission has followed.

When the Hydro-Electric Power Commission of Ontario in 1920 acquired by purchase the properties of the Toronto Power Company, the Commission assumed, as part of the purchase price, certain obligations of the Company, including an issue of guaranteed debenture stock secured by trust deed in favour of the British Empire Trust Company, Limited, of London, England, who were the trustees. This debenture stock was payable in Sterling and the trust deed provided that on any interest date the whole or any part of the stock outstanding could be redeemed at a premium of 5 per cent. upon giving to the stockholders not less than six calendar months' previous notice of intention to effect retirement.

In the latter part of 1932, the amount outstanding was £1,246,699, equivalent at par of exchange to $6,067,268, and the pound Sterling stood at a substantial discount in relation to Canadian money. The Commission considered how best it might take advantage of the favourable exchange conditions then prevailing in respect of the purchase of Sterling, and it gave notice of intention to redeem the whole amount outstanding at May 1, 1933. In order to safeguard against possible rise of Sterling in the six-months interval, the Commission proceeded to purchase Sterling at every favourable opportunity, and acquired, at an average rate of $3.88 to the pound, the requisite quantity of this currency. The Commission was able to retire the debenture stock at a total cost for principal, interest, premium, carrying charges, brokerage charges, sundry and legal expenses, which effected a net saving of more than $844,000.

Another instance involving international exchange with which the Commission has recently dealt is in connection with the retirement of the 5 per cent. first mortgage thirty-year gold bonds of the Electrical Development Company of Ontario, Limited, amounting to $3,271,500, which became due and payable in New York on March 1, 1933, involving with interest the sum of $3,353,287.

Now, during the whole of the month of February, 1933, American funds were at a premium ranging from 18½ at the beginning of the month to 20⅝ per cent. towards its close, a period within which it was necessary to provide funds for the retirement of this bond issue. The Commission was confronted with the problem of how best to avoid, if possible, the purchase of American funds at the high prevailing rates of exchange. At this time also, the Commission experienced additional concern because of the uncertainties of the banking situation in the United States, which led in the early part of March to cessation for a time of banking activities presenting

perplexing problems to those seeking to make international transactions.

Upon careful consideration the Commission negotiated a four-months' loan in New York for $3,300,000 at interest rates of 5 per cent. and later at 4½ per cent. per annum. When repayment of this loan of $3,300,000 became due on June 30th the premium on American funds was then ranging between 9 and 10 per cent., and would thus still involve an exchange expense of from $300,000 to $330,000. The Commission, therefore, concluded to arrange for an extension of the loan period to September 30, 1933, at the same rate of interest. At the end of September an adverse exchange situation still prevailed, but American funds were then being quoted at a premium of approximately 3 per cent. The Commission then sought to further extend the loan period to January 31, 1934, at a reduced interest rate of 4½ per cent. with the option of making repayment any time prior to January 31, 1934, upon giving the lender two weeks' notice. This extension was granted. Almost immediately afterwards, exchange conditions became more favourable to Canada and the Commission paid off the loan. The net result here was that instead of having to pay some $600,000 to $650,000 for adverse exchange, the Commission avoided this payment, and in lieu thereof after the transaction was completed in November, 1933, had a balance to the credit of the municipalities of approximately $9,000.

Various public references have been made to the Commission having to pay exchange at all, but the Commission was simply subject to the prevailing conditions which affected the whole world, including Great Britain and all parts of the Empire.

The foregoing facts are recited at this time because it is believed that those who are interested in following the administrative work of the Hydro-Electric Power Commission of Ontario will, through the consideration of the facts here presented, be assured that the Commission entrusted with the administration of Hydro affairs is at all times alert to use its best judgment and effort on behalf of the citizens of all Hydro municipalities.

The practical application of these two transactions in their net effects upon the financial position may briefly be stated as follows:

You will recall that last year the Commission pointed out that, since *interest* is necessarily a part of the cost of power, therefore exchange costs included in payment of interest in foreign money were equally a part of the cost of power, and the Commission in its capacity of trustee could not treat them otherwise. Now, just as last year both factors of exchange on interest—the unfavourable items less the favourable items—were included in the cost of power; so this year exchange on interest is similarly treated, and the municipalities received, as a reduction in their costs of power, the benefit of the portion of the approximately $844,000 that relates to saving on *interest*.

You will recall also that last year, exchange on payments for *capital maturities* was charged to the Commission's reserve for obsolescence, contingencies and stabilization, and similarly this year, some $825,000 of the total saving that relates to capital

retirement or refunding, will of course, be *credited* to that fund.

To obviate possibility of misapprehension, I may at this point further add that the manner in which these items are specifically applied is not subject to arbitrary decision by the Commission; there are, rather, principles of financial integrity that must be followed by any organization that values public confidence; and, in addition, the Commission as trustee for many partner municipalities must avoid any financial procedure that would be inequitable as between the various municipalities. As you know, last year when a proposal was made that did not fulfil these requirements, the Commission could not accede to it, but this decision was not from any disposition to impose burdens on the current year's operations of the municipalities. The Commission in fact, you will remember, voluntarily withdrew from its reserve, previously accumulated out of revenue, for stabilization of power costs, an amount substantially in excess of the sum involved in the proposal that was rejected, and applied the larger sum in a manner to reduce the municipalities' costs for 1932, doing so, however, with strict equity as amongst all municipalities. Similarly this year, the manner in which the saving of $844,000 on exchange costs is being dealt with is simply such as is necessary to conform to sound financial procedure and strict equity and does not reduce the aggregate of relief that the Commission in accordance with governing principles is affording to the municipalities' power costs of 1933.

In the case of the transaction in New York funds, the situation is that a large payment of *premium has been avoided*, rather than that a large discount was obtained. That is to say, owing to the Commission's action in temporarily refunding the loan in New York until the exchange rate declined, there has been a real saving, but this is a saving of threatened or potential loss, and therefore is not in the nature of a profit on either capital account or current account. The loss that would have occurred had the Commission not taken its action, is simply wiped out or was prevented from materializing by the saving effected, thus leaving the Commission's accounts and the costs to the municipalities unchanged as compared with what they would have been if neither the adverse exchange condition, nor the Commission's action to counteract it, had arisen.

When the detailed adjustments and apportionments are completed they will appear in the Twenty-Sixth Annual Report now in course of preparation.

### RE ABITIBI PURCHASE

There is another matter and one with regard to which rather widespread misrepresentation has been carried on—generally referred to as the "Abitibi purchase"—and although this is not a Hydro matter in the same sense as the other features of the work of the Commission to which I have referred nevertheless as citizens of the Province you may be interested in a brief reference to it.

The association that the Commission has with the Abitibi Canyon power plant and its transmission lines is not—as in the case of our main Hydro undertaking—as trustee for the municipalities, but as the

specially experienced and technically qualified agent of the Government. As you know, the Hydro principle of service *at cost* provides that each municipality shall undertake reponsibility for the costs associated with its own proportionate share of the properties that serve that municipality. Port Arthur, for example, is a Hydro municipality, but it has no proprietary interest in the properties of Eastern Ontario. Similarly, Hamilton has no financial interest in the properties serving Port Arthur or even in the transmission line between London and Windsor. In accordance with this principle, the Abitibi Canyon plant, which is too remote from southern Ontario to be an economical source of supply for the municipalities of that area, and which, even in its own vicinity has no group of strong municipalities sponsoring it financially, could become a publicly-owned undertaking only through the Government assuming the financial responsibility, and consequently this is what the Government has done.

Although no municipality in Southern Ontario, or even in Northern Ontario, has come under any financial responsibility with respect to this northern plant, and cannot under Hydro principles do so except voluntarily; and while one naturally cannot see definitely into the future, yet it may be interesting to you to remember the experience in connection with the Central Ontario system that now forms part of the Eastern Ontario system. This system was initially brought under public ownership as a Government responsibility, and later the municipalities in the area served found it to be to their great advantage, voluntarily, to become members of the municipal partnership. So, just as at the present time there are among you, in the Ontario Municipal Electric Association delegates from cities and towns of the former Central Ontario system, one may at least say that it is not impossible that, at some time in the future, representatives of northern municipalities with a direct interest in northern power properties may be joining in your deliberations.

In view of the present more or less remote relationship of Southern Ontario municipalities to this northern undertaking, I do not intend to refer at any length to the circumstances concerning it. In any event, Premier Henry has in his statements to the Legislature and to the public, fully set forth the various considerations determining the course of Government action that has been taken. I have thought, however, that you would be interested in knowing of the encouraging beginning that this system is making.

The Abitibi undertaking has in its favour the fact of having been acquired at exceptionally low cost. In view of the undue prominence that has been given by some to a ratio of 90 per cent. involved in one element of the transaction, I may remind you of the fact that the bond exchange terms included not only a 10 per cent. reduction of principal, but also waiver of interest arrears, elimination of exchange premiums, and sharp reduction of interest rate on even the reduced principal. Significant of the necessity of taking account of the complete terms of acquisition is the fact, for example, that whereas the

Ontario Power Service bonds acquired by the Commission on behalf of the Government called for payment of interest in the first five years aggregating $5,500,000 American funds, worth at the time of the offer some $6,300,000 in Canadian money, the new debentures of the Commission carry for the same period an obligation of only $3,150,000, or 50 per cent. less. When it is remembered that this reduction is in connection with a cost that was already low, enabling a purchase price of only $13 per horsepower to have been negotiated, it will be appreciated that long before the load on the plant approaches its capacity, the cost of power per horsepower from it will be such as to afford exceptional stimulus to northern mining and other industrial and municipal activities.

The Commission has already established a schedule of rates for mining power that is much below the rates that most mines in the area have heretofore been paying, and, taking account of contracts already negotiated and others in process of negotiation, it is confidently anticipated that the undertaking will at a very early date be meeting all its costs for operation and interest.

The Abitibi plant was placed in operation in June, 1933, with two units of a total capacity of 110,000 horsepower, and it is estimated, with present information, that the minimum revenue for 1935 will be $750,000 from the sale of power.

The Commission's lines completed, and under construction, will serve the following mining districts:—

| | |
|---|---|
| Iroquois Falls and Matheson, | |
| Timmins, | Sudbury, |
| Kirkland Lake, | Patricia, |
| Matachewan, | North Bay. |

Bearing in mind the favourable reaction that is inevitably felt throughout the whole Province when one important part of it has received an impetus to accelerated development,—including, of course, the facilitating of the economical mining of low grade ores—the provisions made in connection with power for the north are to be regarded as cause for added encouragement with respect to general business and to Hydro operations in Southern Ontario.

### USE OF POWER RESERVES FOR STEAM PRODUCTION

Another matter of special interest in 1933 has been the matter of the profitable employment of system reserve generating capacity for industrial steam production. As was intimated in the Commission's Annual Report for 1932, the existence, during the depression, of idle and semi-idle industrial plants in its territory, creates a necessity for the Commission to maintain extra reserve power capacity, *in addition to* the reserve capacity ordinarily required to meet operating contingencies and guard against risk of power interruption. Unless the special power reserve capacity is maintained in times such as the present, idle and semi-idle industries could not resume operation, and they would be definitely prevented from re-employing their temporarily idle workmen.

The arrangements being made in 1932 with a view to deriving revenue from this reserve power capacity, while still keeping it available to safeguard the general industrial situation, have been successful in 1933.

The principal method of utilizing reserve power has been to effect its employment in the production of steam required by pulp and paper mills on the Niagara and Thunder Bay systems. Further quantities of electrical energy have been marketed on an "at-will" basis through the Canadian Niagara Power Company as was done for several years prior to 1930. Towards the end of the year an additional arrangement with the Gatineau Power Company which brings similar financial benefit in reducing the costs of carrying necessary *system reserve power* was in effect.

It should be clearly understood that none of these special measures to obtain revenue from employment of system reserve power capacity are in any legitimate sense a sale of power at less than cost. All of the power supplies from various sources and all of the power utilization, relate to each system as a single comprehensive operating unit; and the reserve power supplies, consequently, cannot be regarded as being identified with any particular portion of the total power supplies of a system.

Under the Commission's arrangements for temporary utilization of reserve power capacity that would otherwise be idle in time of depression, such power is to be supplied or released only as long, and at such periods of the day and year, as it is not needed for immediate use by the primary power users of the Province. It is subject to unlimited interruption or complete recall at any instant. *Every horsepower of the reserve power, therefore, continues at all times to give its full value to the system as absolutely necessary reserve power*, and the revenue derived from its temporary use for steam generation is extra revenue obtained at virtually no cost over and above what the Commission would in any event be obliged to incur to protect the interests of Ontario's power-consuming industries and workmen now idle.

### Re Trend of Demand for Electrical Service

Since speaking to you at your last annual gathering, I believe that your observations will substantially accord with my own conclusions that conditions are such as to make a substantial betterment in the electrical markets, both for electrical energy and for appliances using this commodity.

You will recall that at our meeting in January of last year, Dr. Gaby gave an address in which he dealt with the "Trends of Electrical Demands in Relation to Power Supplies". In this address it was explained that provisions for future power supplies must be based upon the experience of the past; that with the present size of the load a given percentage increase implies a much larger actual addition to the load than formerly; that several years are often required to make available these large additions to generating capacity: that, consequently, estimates of future requirements and adequate provisions for meeting them must be made years in advance.

You will further recall that in his address, Dr. Gaby showed that for eighteen years preceding 1929 there had been a trend in growth of load of 11.4 per cent. per annum, and this growth up to 1929 had been remarkably uniform.

As early as 1924, however, the

Commission had to begin, and in 1926 to consummate, arrangements for the delivery in instalments, commencing in 1928, of 260,000 horsepower of Gatineau power and almost immediately 150,000 horsepower was absorbed and, in 1929, additional power supplies were taken in advance of the contract date. Had the demand continued to follow the established trend of eighteen years, the six years subsequent to 1929 would have called for an increased load of 800,000 horsepower. Now, the Commission did not, of course, expect the growth of load to continue *indefinitely* at the established rate—in these considerations the question of saturation has to be remembered—but at this period the Commission had no assurance that its load would not continue to increase for several years at a high rate. It therefore consummated arrangements that were already under negotiation for a total of 567,000 horsepower, which included 471,000 horsepower of purchased power, to be delivered over a period of years. This was a provision not at the former 11.4 per cent., but only at 7.7 per cent. increase per annum.

Moreover, in making these arrangements the Commission had in mind that for several years it had been compelled to carry on almost at "hand-to-mouth" procedure with regard to supply and demand in its power markets. Many large public utilities maintain, even in normal times, a reserve power generating capacity of more than 30 per cent., and the Commission aims at preserving a *minimum* of 10 per cent. The provisions for additional power just referred to afforded the Commission its first substantial opportunity of providing for some stable reserve capacity.

Subsequent to 1929, the reduced scale of operations by certain large industrial power consumers necessarily lessened their power and energy demands and in some cases to a degree that brought their actual demands below even the minimum quantities for which, under their contracts, they continued to pay. The Commission, however, was still under contractual obligation to supply the full quantities of power to these consumers and it was essential to take account of these factors in appraising the relationship between the supply of, and demand for, power on the Commission's systems during these years.

You will appreciate that the presentation of figures relating to loads of an enterprise as large as that of the whole Hydro undertaking, in a manner that will adequately convey an understanding of the influence of the many factors which contribute to growth, is a difficult task. This is true even in circumstances which permit the use of elaborate graphic and tabular data. To-day I shall simply offer you some of the significant totals and some conclusions warranted by our studies.

The arithmetical sum of the Niagara system 25-cycle and 60-cycle peak loads for December, 1932, was 886,863 horsepower and for December, 1933, 1,186,005 horsepower. The all-systems total Canadian load in December, 1932, was 1,037,957 horsepower which may be compared with 1,440,046 horsepower for December, 1933. Lastly, the all-systems grand total of all loads for December, 1932,

was 1,090,236 horsepower, which compares with 1,514,040 horsepower for December, 1933.

Now, with respect to *primary load* reference to available statistics, including those already published, will show that for the calendar years 1930 and 1931 the general trend of the Commission's primary load was downward. During 1932 this downward trend was checked. In the early months of 1933 the load again slumped somewhat sharply, but the important point to observe is that before the close of Spring the trend turned decidedly upward and soon recovered the lost ground. This upward swing, when measured as the sum of the lost ground which was regained and the actual load increase made thereafter, is of the order of a 10 per cent. gain. This figure, according to the factors affecting it, varies somewhat but is always substantial. The actual gain at the close of the last fiscal year may be further judged from figures for total energy consumption for primary power in Ontario for the month of October, 1933, which show an increase of nearly 7 per cent. over the corresponding month of 1932.

These figures, relating as they do to primary power loads only, are of special significance with respect to increases in load directly attributable to improved general conditions.

Turning now to the *total energy* distributed by the Commission in the Province of Ontario at the close of the past fiscal year, we find an increase for the month of October, 1933, compared with the previous October, of about 19.5 per cent. The explanation of this remarkable increase lies in the sale of secondary power in Ontario, principally for the production of steam as employed under the circumstances already referred to.

In former published statements attention has been drawn to the fact that much of the decrease in the Commission's total load was due to the loss of large blocks of industrial power. In 1933, also, there were a few specially large losses of power load. It is gratifying, however, to be able to point to the fact that the general upward trend of load has been such as to take up in other industries these losses that have occurred in the past year and even to show some increased consumption.

As supplementary to these comparisons with last year's loads, it is an encouraging fact that during last December the total peak of all systems combined exceeded any previously recorded peak by nearly 180,000 horsepower; the actual figures show for December, 1933, a peak of 1,514,040 horsepower and for December, 1930, the former all-time maximum, 1,331,278 horsepower. It is equally interesting to note that during the month of December, 1933, the all-systems energy production in kilowatt-hours exceeded the monthly record in any former year by about 80,000,000 kilowatt-hours. In the month of December, 1933, 574,463,096 kilowatt-hours were produced as compared with the former maximum in the month of October, 1930, of 492,089,858 kilowatt-hours.

### THE PRESENT STATUS

Our annual analyses and adjustments among the various co-operating municipalities are in the process of compilation, but I feel we are far

enough ahead to enable me at least to present some financial and other data that will representatively show our present status.

We find that the capital investment by the Commission on behalf of the co-operative enterprise, in generating plants, transmission lines and other collective undertakings, exceeds \$287,000,000. The capital investment by the municipalities in distributing systems and other assets exceeds \$112,000,000. The total investment in the Hydro undertaking is thus no less than \$399,000,000.

Financial results of the Hydro undertaking for the year 1933 will reflect not only the improved circumstances that obtained towards the end of the year but also the relatively adverse business conditions of the earlier months. Nevertheless, it is anticipated that when it is possible to present complete data for the whole year an eminently satisfactory position will be shown. I expect that over \$2,500,000 will have been added in 1933 to the financial reserves of the Commission and over \$3,000,000 by the municipalities, making a total in excess of \$5,500,000 for both, which safeguard the Hydro undertaking, bringing the additions to reserves that have been made during the past four years up to more than \$36,000,000, of which the Commission has added \$21,500,000 and the municipalities \$15,000,000. The total reserves of the Commission, in respect of power properties only—that is, excluding some \$4,000,000 of reserves for insurance and pensions—will exceed \$64,000,000, and, with those of the municipalities, will approximate \$125,000,000.

The Commission now serves 757 Ontario municipalities, including 27 cities, 96 towns, 269 villages and police villages and 365 townships.

A department of the Commission's activities that, even under the most adverse circumstances, has continued to expand year by year without interruption, is the distribution of rural electrical service. Applications from new rural consumers were received in 1933, which justified the Commission in authorizing the building of no less than 320 miles of primary distribution line in its rural power districts, bringing the total mileage to more than 9,170 miles. In the rural power districts there will be invested some \$20,110,000, of which nearly \$10,000,000 has been granted by the Government in pursuance of its long-established policy of assistance to agriculture. Nearly 62,000 farm and hamlet consumers are served in rural power districts, this being about equal to the total number of domestic, commercial light and power consumers in the cities of Hamilton and London combined.

In view of the general circumstances we have had under review, coupled with the hope now being more widely held of actual recovery from the former severity of the economic depression, may we not take courage and with renewed confidence strive for the further development as well as for the preservation of our great co-operative Hydro undertaking?

# Principles and Facts, Public Utility Merchandising

## Prepared by the Merchandising Committee, Association of Municipal Electrical Utilities

*(Presented to Ontario Municipal Electric Association, at Toronto, February 1, 1934)*

WHEN the Hydro-Electric scheme of the Province of Ontario was inaugurated there were very few private shops where electrical appliances could be purchased and practically no service organizations to look after repairs.

All electric utilities whose business it is to distribute electrical energy are confronted with the problem of building load and in order to satisfactorily dispose of kilowatt-hours and build up a satisfactory load it is almost imperative that means be devised of disposing of the things which will utilize electric current.

It has been found that to leave the entire development of the appliance field to private electrical dealers or contractors results in a very slow development of load, and the establishment of load conditions not at all desirable because of the lack of control over the size and type of appliances being connected to local distributing systems, and of the creation of a host of dissatisfied customers because of appliances not always properly demonstrated and sold, resulting in large bills for current and complaints to the central station for poor and expensive service.

There is a necessity for an institution with stability, financial strength and probable long existence to stimulate the sale of electric current through its many uses by promoting the use of electrical appliances, to sell these appliances to consumers and to keep them in constant operation, particularly in order to build up in the minds of the general public a lasting confidence in things electrical and to insure the most rapid development of the electrical appliance field.

To further this development it is necessary also to carry on extensive promotional and educational advertising. It has been found that central stations are required to do most of this type of advertising. Electrical dealers do not as a rule carry on extensive newspaper or bill-board advertising, conduct demonstrations, circularize all electrical consumers or do other promotional work for the benefit of the central station.

This does not mean that private electrical dealers have no place in the scheme of appliance distribution—they fill a very important place in every community. The more shops there are for the disposal of good electrical appliances the quicker will be the realization of the hope of a satisfactory load condition, but central stations should lead the way and set a high standard example for others to follow.

It is found also that where the central station carries on a regular

promotional campaign the electrical appliance business thrives, and, conversely, where the central station is indifferent to the sale of appliances there is a considerable lag in the appliance business generally. Where central stations merchandise there is an added stimulus given to the appliance business which reflects on the business done by private dealers and others engaged in this line of endeavour.

Hydro Shops throughout Ontario in the main have been established for the following purposes:

1. To promote the use of electrical current by the sale of electrical appliances.

2. To foster a spirit of co-operation with electrical dealers in each municipality to encourage them to promote Hydro interests as well as their own.

3. To uphold the standard of electrical appliances used on Hydro lines by encouraging the sale of only the best.

4. To maintain in service all electrical appliances on consumers' premises to insure maximum current consumption.

5. To develop the proper kind of load by encouraging the sale of certain appliances and discouraging the sale of others.

6. To educate consumers in the proper way to operate appliances to insure complete satisfaction to them and to keep bills within bounds.

Since the establishment of Hydro Shops a great many dealers and contractors selling and installing electrical appliances have come into existence and have benefitted by the promotional work and experience of the local Hydro Systems. A large number of these dealers and others have been unable to remain in business largely through their own lack of business experience or financial strength and while many of them blame the Hydro for their inability to carry on, in the majority of cases Hydro Shops are responsible for them remaining in business as long as they have rather than in their failure.

Contractor dealers as a rule are interested only in selling electrical appliances at a profit to themselves, whereas the Hydro Shop is interested in their sale so as to promote the use of electricity and in this way lower the rates to all classes of consumers.

In answering some of the criticisms which have arisen against the operation of Hydro Shops, a few of these criticisms are enumerated with an explanation of Hydro policy with reference thereto.

1. It has been stated that Hydro Shops pay no taxes.

In answer to this, let it be known that enabling legislation has been passed on the recommendation of the Hydro-Electric Power Commission by which Hydro Shops are subject to exactly the same municipal taxation as other merchants of Hydro municipalities, and in most municipalities where a Hydro Shop is in operation business taxes have been levied and paid on this basis for years.

2. Hydro municipalities use public money and depend on unfair competition to carry on a merchandising business.

The funds of a local Commission are not exactly public funds in the same sense as taxes but the property of the consumers themselves, these consumers being shareholders in the Hydro enterprise, and it is held to be

just as legitimate for Hydro consumers to engage in the merchandising of electrical appliances to promote the use of electricity so as to bring about a reduction in rates as it is for the shareholders of privately owned utilities, both gas and electric, to engage in merchandising their respective appliances to promote increased business so that larger dividends could be paid. Local Commissioners, acting in the capacity of trustees for their consumers, are naturally guided by what is in the best interests of these consumers and it is considered that to do the greatest good to the greatest number of consumers it is necessary to operate a Hydro merchandising establishment.

3. It has been suggested that instead of carrying on merchandising business local Commissions should establish showrooms for the display of electrical appliances of all kinds and makes for the benefit of electrical dealers.

On account of the numerous manufacturers and dealers it is practically impossible to satisfy all and to provide space without incurring tremendous expense to provide this convenience. It has been found where this policy is to some degree in effect that dealers and customers alike become dissatisfied with the facilities offered and with the antagonism that may be created from the efforts of dealers themselves especially if more than one is present when a prospect turns up. In large communities it would be impossible to have all dealers represented on the Hydro floor at one time and charges of discrimination would easily arise if allotment of time and space were resorted to.

4. Through Hydro merchandising and Hydro collection methods private merchants found it hard to make collections.

From a strictly business point of view all merchants should first of all select their customers on a credit basis and make such arrangements with these customers when purchasing on the installment plan that installments will be paid when due. A proper follow-up of installments should enable a private dealer to make collections as readily as the Hydro and while it is claimed that Hydro municipalities threaten to cut off the service for non-payment of installments on merchandise, this practice is not indulged in. If an appliance has been properly sold, if it is a good appliance giving no trouble and the contractor dealer is serving the customer, there is no reason why his accounts should not be paid.

5. Through Hydro's preferred buying power manufacturers extend discounts which are used to compete unfairly against other merchants.

Most manufacturers of electrical appliances prefer to deal with Hydro municipalities for reasons of their own, for some of which Hydro Shops are in no way responsible. On the majority of electrical appliances sold in Ontario the manufacturers set a resale price and except in rare cases these prices are maintained. If larger discounts are given to the Hydro Shop because of larger volume of buying, the excess gross profit is devoted to the servicing of all appliances and rendering Hydro service more attractive than the average dealer would care to do.

6. It is claimed that if Hydro Shops discontinued merchandising the vol-

ume of business now enjoyed by Hydro Shops and dealers combined would be spread among the dealers only.

It has been proven that where central stations discontinue merchandising not only does the volume of business decrease but other agencies enter the field to lower the dealers' volume. It is a well-known fact that department stores, through their mail order departments and branches, enter into aggressive competition with the dealers and as very often these large institutions conduct sales at low prices, lower than list, they destroy the stability which the electrical appliance business otherwise enjoys. Where department stores, particularly mail order, sell appliances, customers purchasing them are left without a satisfactory service depot.

Another fact which has been demonstrated is that where aggressive central station merchandising is not carried on, manufacturers establish retail depots, thus depriving the resident dealers of sales which they might otherwise enjoy.

7. It has been stated that in the opinion of some, the electrical appliance field has been practically saturated, that what business remains belongs to the electrical dealer. The census of the appliances in use among Hydro consumers at the end of 1932 shows that as far as the larger appliances are concerned at least, we are a long, long way from saturation as the following table will indicate:

| Appliances | Percent. Saturation |
|---|---|
| Electric Ranges | 26.5 |
| Electric Hot Plates | 13.3 |
| Electric Washers | 33.6 |
| Electric Vacuum Cleaners | 26.2 |
| Electric Water Heaters— | |
| Flat Rate | 2.04 |
| Metered | 7.03 |
| Electric Grates | 4.5 |
| Electric Air Heaters (Port.) | 31.5 |
| Electric Ironing Machines | 1.16 |
| Electric Irons | 93.5 |
| Electric Refrigerators | 8.3 |
| Electric Toasters | 49.5 |
| Electric Grills | 10.1 |
| Electric Furnace Blower and Oil Burners | 2.5 |

From these figures it would appear as though not only the contractor dealers but the Hydro Shops as well and Hydro municipalities where merchandizing is not carried on, have a wonderfully fertile field for the development and sale of electrical appliances of all kinds and with the new devices which are appearing on the market periodically, there seems to be no limit to the possibilities of sale.

While the figures above show the number of appliances in use up to the end of 1932, it must be remembered that a great many of these appliances are continually wearing out and require replacement, thus enlarging the sale possiblities for contractor dealer and Hydro Shop alike.

8. It has been said that unfair competition exists where Hydro Shops have been established as exclusive agents for certain manufacturers.

This condition has been brought about largely by the manufacturers themselves who desire to reduce to a minimum the number of accounts on their books, to increase the volume for each outlet with corresponding reduction in selling and advertising costs. Dealers have similar privileges and a great many exercise these privileges

to the detriment of a Hydro Shop. A further reason why it is desirable to carry an exclusive agency for major appliances lies in the fact that the stock of repair parts for service work is kept to a minimum. This is particularly desirable in small communities.

9. It is sometimes said that Hydro Shops extend the time of payment for appliances over long periods, also give excessive trade-in allowances.

The policy adopted by Hydro Shops throughout the Province some years ago limited the time over which installments may be spread to 18 months and that only in extreme cases, 12 months being the regular practice. Trade-in allowances on old equipment either gas or electric, have been very much discouraged by Hydro Shops. Only in a few cases have they been indulged in and then to a minimum degree. Occasions have come to light, however, where competitors of the Hydro have offered exorbitant trade-in allowances on electric ranges and other electrical equipment and that as high as three to five years have been allowed for the payment of installments on gas equipment. It has also come to light that department stores and other dealers offer longer terms than Hydro Shops and have more liberal policies regarding trade-in allowances than those offered by the Hydro.

10. It has also been suggested that the dealers in electrical appliances perform as good a job as do the Hydro Shops if left to their own resources.

Over a period of years statistics show that where Hydro Shops have been in operation and have been at all aggressive, there is a marked difference between the number of large current consuming appliances in use and the average consumption of current among domestic consumers. To illustrate this point a few appliances have been selected out of the large number that may be in use, namely, electric ranges and water heaters. In four Hydro Shop towns, namely, Stratford, London, Chatham and Picton, in 1924 the saturation of electric ranges was 25.5 per cent., in 1932 43.2 per cent. In four non-Hydro Shop towns, namely, Brantford, Scarboro, Brampton and Preston, the saturation in 1924 was 21.2 per cent. and in 1932 28.5 per cent. The increase in Hydro Shop towns was from 25.5 per cent. to 43.2 per cent., or approximately 75 per cent. That in the non-Hydro Shop towns selected was from 21.2 per cent. to 28.5 per cent., or approximately 33 1/3 per cent. over a period of eight years.

In the case of water heaters the saturation in the above Hydro Shop towns in 1924 was 3.8 per cent and in 1932 12.0 per cent. In the case of the non-Hydro Shop towns the saturation in 1924 was 3.2 per cent. and in 1932 9.7 per cent.

The reason such a small number of Hydro Shop towns and non-Hydro Shop towns were selected for these comparisons is that the figures showing the number of appliances in use in 1924 for the articles mentioned above were not available in very many municipalities at that time and it was necessary to take the figures which were available.

To again illustrate the effect of merchandising on consumption a larger number of Hydro Shop towns were selected, those representing the ag-

gressive merchandisers: Belleville, Bowmanville, Chatham, Guelph, Galt, Goderich, Ingersoll, Kitchener, Midland, Mitchell, Napanee, Picton, Sarnia, Stamford Twp., Strathroy, Stratford, St. Marys, Welland, Walkerville, Windsor. A corresponding number of non-Hydro Shop towns were slected: Aylmer, Barrie, Brampton, Brantford, Brockville, Blenheim, Dundas, Georgetown, Carleton Place, Gravenhurst, Hanover, Hespeler, Huntsville, Leamington, Listowel, Lindsay, Merritton, Paris, Peterboro, Preston, St. Catharines, Simcoe, Smiths Falls, Thorold, Whitby. The total number of domestic consumers in the latter class agreed with the total number of domestic consumers in the Hydro Shop towns. In the case of the Hydro Shop towns the average consumption of domestic consumers during the year 1932 was 1,643 kilowatt-hours and in the non-Hydro Shop towns the average consumption was 1,311 kilowatt-hours, a difference of 332 kilowatt-hours, or over 25 per cent.

To illustrate the importance of domestic consumption in the field of electrical distribution the consumption of current by domestic Hydro consumers may be of interest. During the year 1932 the total consumption by domestic consumers in Ontario was 740,900,000 kilowatt-hours. This figure increased by transmission, transformation and distribution losses represents approximately 1,000,000,000 kilowatt-hours at the generating station. The total kilowatt-hours purchased and generated by the Commission during the year 1932 was according to the Annual Report, 4,208,000,000 kilowatt-hours which means that approximately 25 per cent. of the power available by the Commission is required for domestic purposes.

If we consider now the fact that the average domestic use in Ontario during 1932 was 133 kilowatt-hours per month, that the average possible consumption among domestic consumers is well over 1,000 kilowatt-hours per month, it is possible for domestic consumers through the use of appliances which they all need, to increase their consumption six fold which would require an additional 6,000,000,000 kilowatt-hours of energy or half again as much as that now distributed by the Commission in Ontario to all consumers, power and otherwise.

These facts are presented only to show the possibilities of development in the electrical appliance field.

*Spillway falls, Alexander development.*

# Copper

By O. W. Titus, Consulting Engineer, Canada Wire and Cable Company, Limited; Standard Underground Cable Company of Canada, Limited, Toronto

*(Presented to Association of Municipal Electrical Utilities at Toronto, February 1, 1933).*

I APPRECIATE greatly the opportunity you have given me of speaking to you to-day. The time allotted does not permit more than a hasty review of what is obviously a very large subject. I am dealing with a few aspects of the subject only.

General

Copper is a metal peculiarly well fitted to be of use to man. It possesses a happy combination of workability, durability and strength.

It is crystalline in structure on the isometic system. It can be worked by rolling, drawing, hammering, extruding and in fact by practically any method used in working metals. This ease of working combined with its high resistance to weathering and corrosion, and its frequent occurrence in nature, has resulted in its early and continued popularity, first as an ornament and later for weapons and tools. It owes its durability largely to the oxide which forms on weathering adhering closely to the copper and protecting it from further oxidation. Iron, as you know, also oxidizes on weathering but the oxide scales off and exposes fresh surfaces of metal to further oxidation.

The, to us, most important property of copper is its low resistance to the flow of an electrical current. There are other metals of lower resistance than copper (e.g., silver) but copper is fortunate in possessing with its low resistance, cheapness, strength, durability and ease of working. It is this happy combination which makes copper the principal metal of the electrical industry.

A rival in specialized sections of the electrical field is aluminum, which has a resistance about 1.6 times that of copper for the same dimensions. However, aluminum is much lighter than copper, only weighing about one-third as much. Aluminum has the serious disadvantage of being weaker than copper and frequently requires mechanical reinforcement. The consequence is that aluminum offers serious competition for copper only where bulk is not objectionable, or even desirable, as for example on high voltage overhead transmission lines. Even here, however, there is present indication that copper will regain some of its lost ground particularly for extremely high voltages on account of its ease of working, high strength, resistance to fatigue and adaptability to being formed into special shapes. The last big transmission line contract placed in the U.S.—that from the Boulder Dam to Los Angeles was for copper.

Here a special construction known as Type "HH" (see Fig. 1) was employed such that the necessary

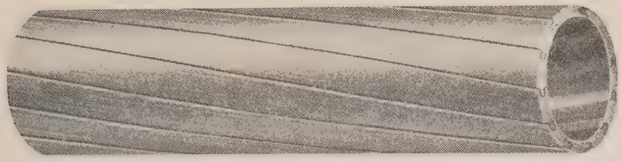


*Fig. 1—"H H" hollow-core transmission conductor.*

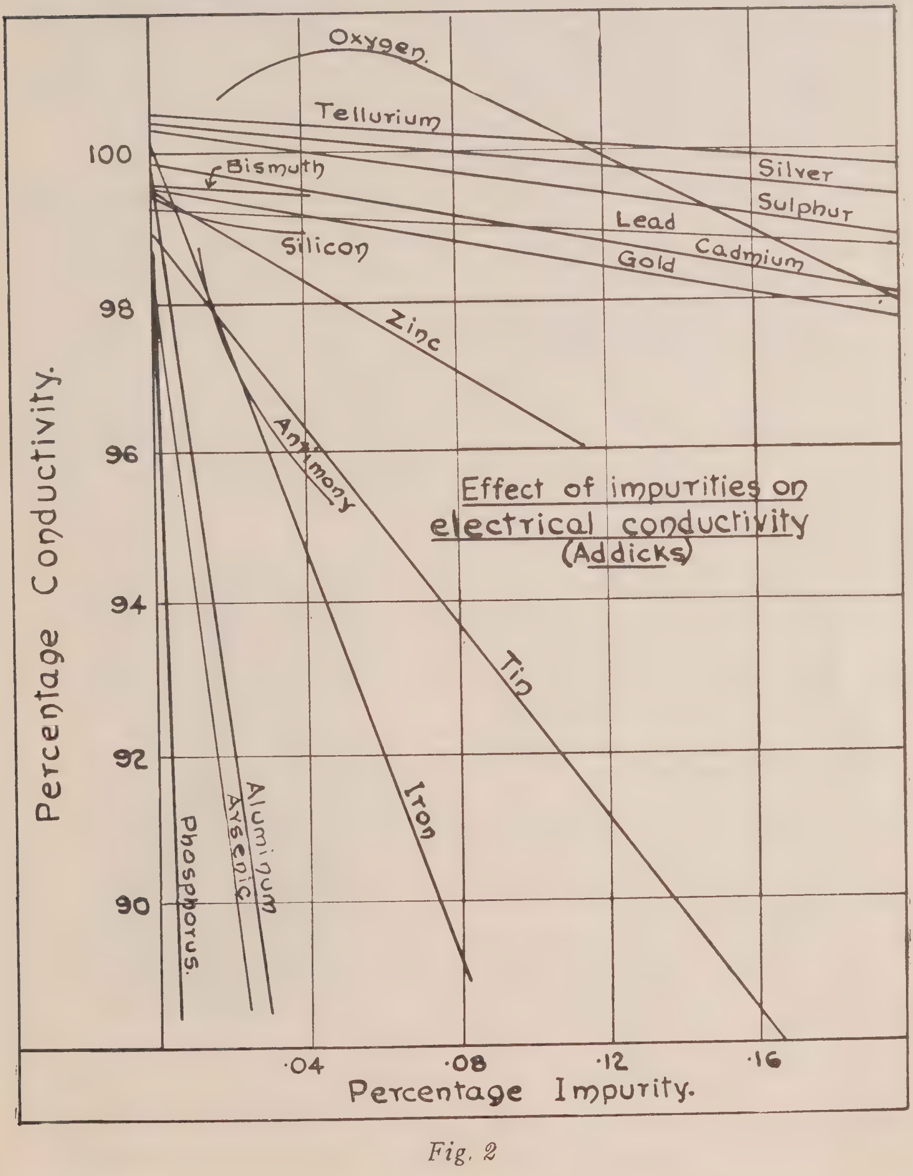



*Fig. 2*

diameter to prevent undue corona loss was reached without an excess of metal being left in the centre where it would serve no useful purpose and only add to the weight. The high strength of copper, since it required no mechanical reinforcement permitted the utilization of this highly efficient form of construction. It is anticipated that this construction will be especially resistant to the vibration troubles which are such a serious problem where tensions are high in relation to weights per foot.

In most applications the greater compactness of copper for a given maximum resistance and its ease of jointing and handling results in a minimum overall cost and places copper without a serious rival as a conductor of electricity.

Slight amounts of impurities have a serious effect on the conductivity of copper, necessitating the manufacture of a metal of a high state of purity to ensure a satisfactory product for the electrical trade. As the conductivity is a readily determinable property it is an inexpensive means of checking the purity of the metal.

Fig. 2 illustrates the effects on the conductivity of the presence of small percentages of impurities[5].

Copper alloys (that is—unites as a metallic solution) with other metals. It possesses this property to an extraordinary degree. A study of its many alloys with zinc or tin alone is a lifetime work. Alloys of copper with zinc are known as brasses; with tin as bronzes. These series of alloys offer to the user a large variety of materials of various strengths, ease of machining, general workability, beauty, corrosion resistances, and conductivities. In general one may say that alloying of copper increases its strength, hardness and resistivity.

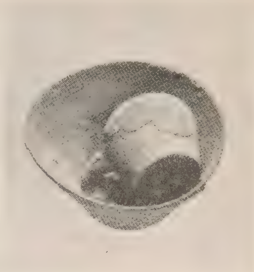


*Fig. 3—From the Lisht excavations were obtained this copper ewer and bowl, over 4,000 years old.*

### Historical

Historically copper was the first metal used by man, being known in Chaldea and Egypt as early as 5000 B.C., and systematically mined in Egypt as early as 3800 B.C.

*Fig. 4—Still in a state of extraordinary preservation is this Bronze strainer, first used in an Egyptian home during the 10th century B.C.*

Time does not permit of a record of its history but the name of the "Bronze Age" of man bears evidence of the importance of the alloys of copper in the development of civilization. An important source of copper in Roman times was the Island of Cyprus, from which through the Roman word for copper "cuprum" it derives its modern name of copper. It is probable it was discovered either in its native state, it being one of the few metals occurring as a metal in nature, or through accidental reduction by an ore, probably an oxide, being used in building a fireplace.

With the advent of iron and steel it lost much of its early importance but regained much of its high estate with the advent of electricity.

TABLE NO. 1

PROPERTIES—Copper Wires

| | Hard Drawn | Annealed |
|---|---|---|
| Tensile Strength (lb./in.$^2$) | 49,000 to 67,000(1) | 36,00 to 40,000(2) |
| Young Modulus of Elasticity (lb./in.$^2$) | 17,600,000(3) | 18,300,000(3) |
| Modulus of Torsion (lb./in.$^2$) | 6,150,000(3) | ........ |
| Proportional Limit (lb./in.$^2$) | 37,000(4) | Not Determinable |
| Elongation at Fracture (in 10 inches) | 1% to 4% (Approx.1) | 20% to 35%(2) |
| *Electrical Resistivity—Ohms/Metre-gram (International Annealed Copper Standard) | | 0.15328(4) |
| Electrical Resistivity—Ohms/Mil-foot (International Annealed Copper Standard) | | 10.371(4) |

| | |
|---|---|
| Temperature Coefficient of Resistivity (per deg. C. at 20 deg. C.) | 0.00393(4) |
| Temperature Coefficient of Resistivity (per deg. F., at 68 deg. F.) | 0.00218 |
| Specific Gravity (grams per cubic cm.) | 8.89(4) |
| Melting Point (deg. Cent.) | 1083(3) |
| Boiling Point (deg. Cent.) | 2100 to 2300(3) |

Coefficient of Linear Expansion ........................... 0.000009255
(per deg. F.)
Coefficient of Linear Expansion ........................... 0.00001666(4)
(per deg. C.)
Specific Heat ........................... 0.0917(4)
(Water—1)
Specific Thermal Conductivity,— ........................... 0.918(4)
(calories, per deg. C., per sq. cm, per cm, per sec.)

* Hard Drawn Copper has about 2 per cent. higher resistivity than annealed copper.

Actual resistivities vary somewhat and it is not unusual to find "conductivities" of annealed electrolytic copper as much as 1 per cent. or more greater than 100 per cent. of the I.A.C.S.

The values above are given as representative averages for working purposes for copper wires. Many of them will vary somewhat with varying processing of the metal or test technique. The properties of usual

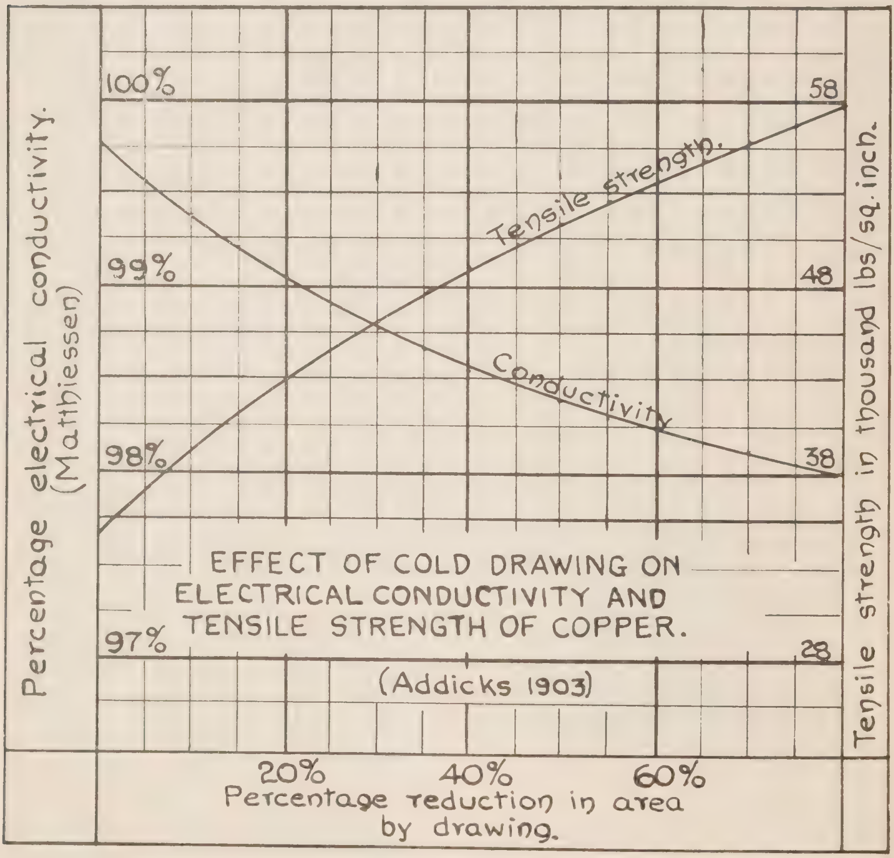



*Fig. 5*

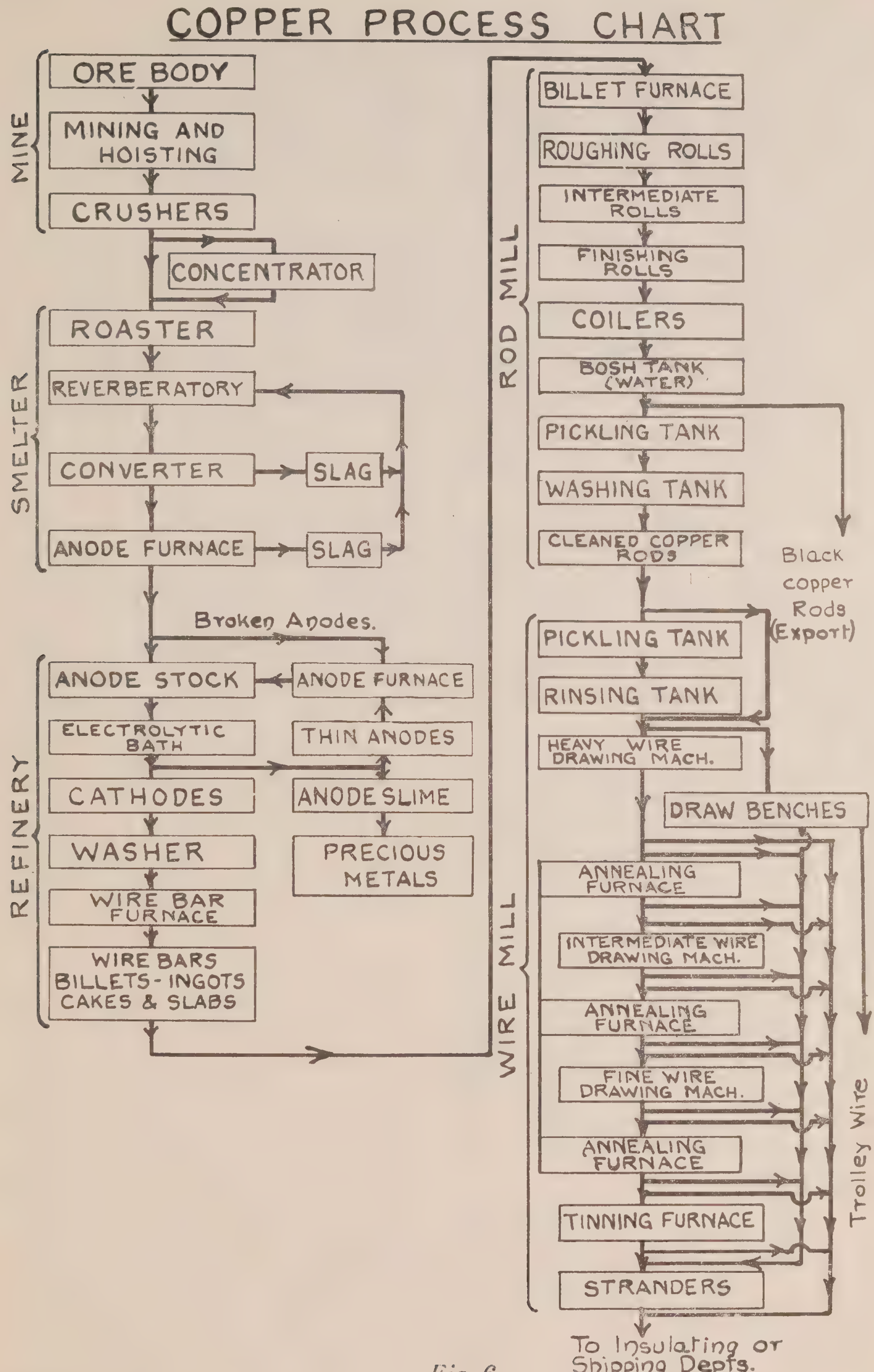
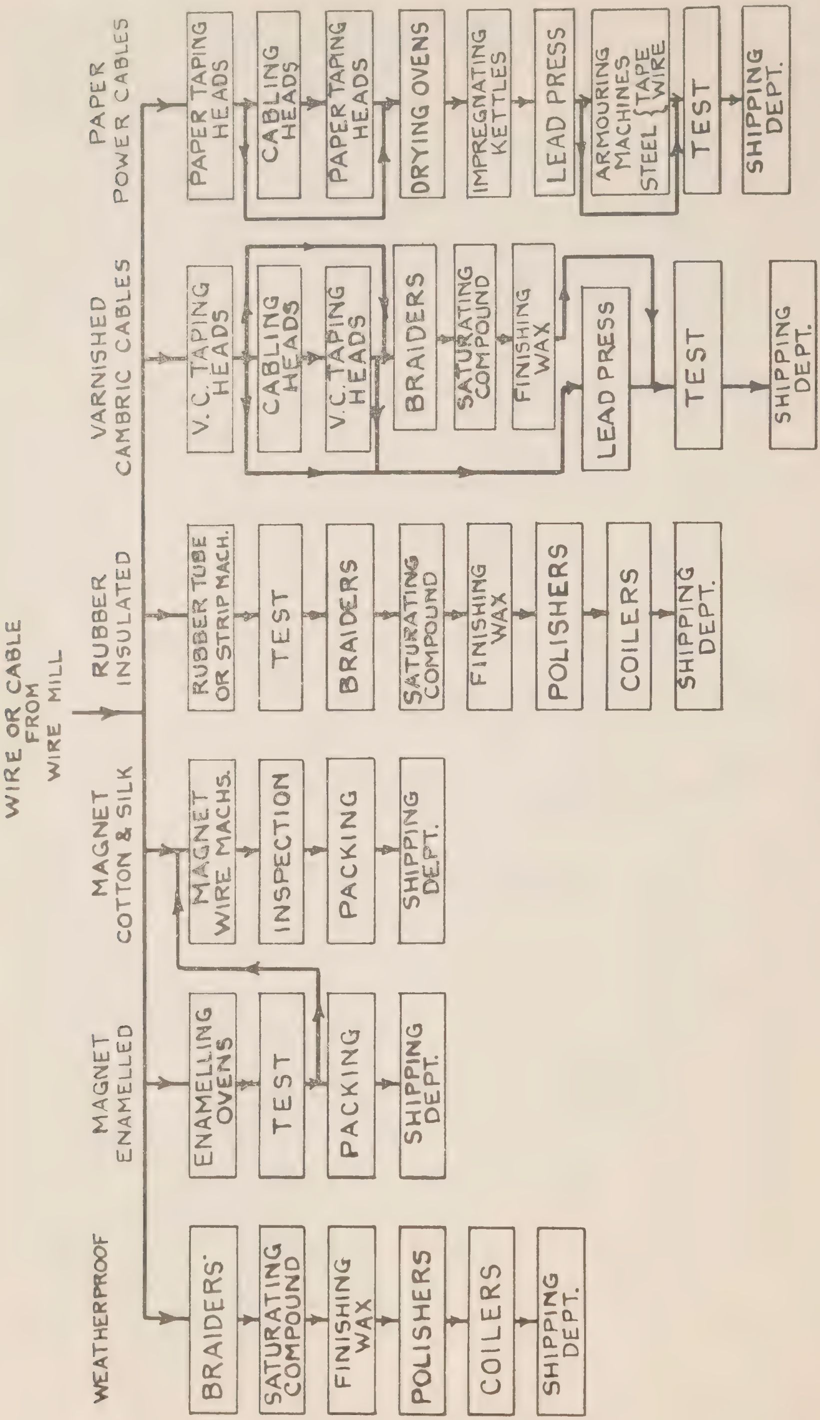

COPPER PROCESS CHART
MINE
ORE BODY
MINING AND HOISTING
CRUSHERS
CONCENTRATOR
SMELTER
ROASTER
REVERBERATORY
CONVERTER
SLAG
ANODE FURNACE
SLAG
Broken Anodes.
REFINERY
ANODE STOCK
ANODE FURNACE
ELECTROLYTIC BATH
THIN ANODES
CATHODES
ANODE SLIME
WASHER
PRECIOUS METALS
WIRE BAR FURNACE
WIRE BARS BILLETS - INGOTS CAKES & SLABS
ROD MILL
BILLET FURNACE
ROUGHING ROLLS
INTERMEDIATE ROLLS
FINISHING ROLLS
COILERS
BOSH TANK (WATER)
PICKLING TANK
WASHING TANK
CLEANED COPPER RODS
Black copper Rods (Export)
WIRE MILL
PICKLING TANK
RINSING TANK
HEAVY WIRE DRAWING MACH.
DRAW BENCHES
ANNEALING FURNACE
INTERMEDIATE WIRE DRAWING MACH.
ANNEALING FURNACE
FINE WIRE DRAWING MACH.
ANNEALING FURNACE
TINNING FURNACE
STRANDERS
Trolley Wire
To Insulating or Shipping Depts.

*Fig. 6*




INSULATING PROCESS CHART

Fig 7.

chief importance to us are the tensile strength and the resistivity. These are particularly dependent on the prior processing of the copper. Fig. 5 illustrates this relationship[5].

### Production

Figures 6 and 7 are a generalized chart of the course the copper follows in finding its way from the ore in the mine to the product ready for your radios, motors, cross-arms, conduits and ducts. As methods differ considerably with different producers, on account of types of ore, local conditions such as cost of power, fuel and labour, etc., etc., the methods followed by the Noranda Mines Limited, Canadian Copper Refiners Limited, and the Canada Wire & Cable Company Limited are taken as the basis for the chart. It will be understood, of course, that there are a number of variations and complications which are not illustrated as they would complicate the description, and become so involved as to defeat the purpose of the paper. The following written matter should be considered in the light of explanatory notes to be read in conjunction with the chart.

Copper *occurs in Nature* in all continents, most countries having it in some small measure at least, this doubtless being one reason for its early discovery and importance to man. The present greatest commercial deposits are in the United States, South America, Africa (both Belgian and British) and Canada. The principal deposits from a commercial viewpoint in Canada are at Noranda, Quebec, Sudbury, Ontario, Flin Flon and Sherritton, Manitoba, and in British Columbia where several important developments include copper as a product.

Copper is mined as a native metal in Northern Michigan but its principal sources are its ores, these being sulphides, oxides, carbonates, silicate, sulphates, oxychloride. Sulphides are much the most important commercially. Oxides are usually the result of other types of ore lying at or near the surface and weathering. The ore bodies at Noranda with which, as mentioned above, it is proposed to deal as an example, are sulphides of copper containing important quantities of gold and silver, and occur in large lens-like masses at various depths.

### Mining and Smelting

In *mining* the ore body is drilled, charges of explosive set, the charges exploded, the broken ore loaded into three-ton ore cars and drawn by storage battery locomotives to storage pockets near the shaft. The ore is loaded from these pockets into skips and hoisted to the surface which, at present, is anywhere up to 1,500 ft. above. Eventual mining will be done at much greater depths. When one considers the weight lifted and the distances involved it can be appreciated why cheap power is such an important consideration, also why mining is such an important outlet for electrical machinery in Canada.

The principal *crushers* are located at the shaft head, but actually below the surface. Both jaw and cone type crushers are used to break the mine rock down to a maximum of ⅜ in. diameter.

The richer ore goes direct to the smelter, leaner ore digressing at this

*Fig. 8—A modern Canadian copper mine and smelter.*

point to the *concentrator.* The first step of the concentrating is that the ore is prepared for the flotation process by being finely ground in ball mills. This is accomplished by the ore being tumbled around in a large steel container together with a number of very hard steel balls until the ore is pulverized to pass a 200 or 300 mesh. The flotation process is one utilizing the surface tension of certain oils. It is found that the valuable ores are carried to the top when air is bubbled through these oils in the presence of the finely ground ore. The copper and precious metal bearing sections on being carried to the surface overflow into other tanks and are there collected. The dividing line between direct smelting ore and concentrating ore varies with copper and gold prices and with the relative quantities of these metals in the ore. At present ore containing up to $2.00 or $3.00 per ton of gold and about 3 per cent. copper would go to the concentrating mill. Here it is concentrated in the ratio of about 5 to 1.

Both direct smelting and concentrated ore then proceed to the *roasters* which are what amounts to a large spiral tray with the ore in a relatively thin layer. Here a great part of the sulphur content is burned off bringing it down to about 12 per cent.

The next step is the *reverberatory furnace.* This is a large melting furnace heated by powdered coal where the ore is melted together with a siliceous flux. The copper and precious metal ore separates out and stays at the bottom of the furnace, the waste rock, mixed with silica, melting and rising to the top where it is drawn off as slag. The product of this process is known as *copper matte* and contains about 20 per cent. copper, the remainder being iron and sulphur principally.

The copper matte, in molten form, is introduced into the *converter* where air is blown through together with

powdered siliceous flux, the object of this operation being to burn off the iron and sulphur. The heat for this process is supplied by the actual burning of the iron and sulphur in the matte and does not require any external heat. The flux carries off the iron oxide, rising to the top as slag, which is poured off, and since it, the converter slag, contains some copper it is returned to the Reverberatory Furnace for re-treatment.

The copper is then poured off and is what is known as *blister* copper, still containing some sulphur and being characterized by large blisters on the surface, due to the expulsion of gases, such as sulphur dioxide during the solidifying process, if solidifying were permitted, as it often is when the Anode Furnace is not located at the Smelter.

Proceeding to the *anode furnace* air again is blown through the molten Blister Copper but, since most of the sulphur and iron were removed in the converter, external heat, (from powdered coal), is necessary. In this furnace the remainder of the sulphur and iron are burned out and an excess of copper oxide formed. As this excess of copper oxide is not permissible in the finished copper it is reduced by "poling". In this "poling" green wood poles are introduced into the molten metal removing the excess of oxygen, so as to provide tough copper. The copper is then poured into moulds, about 700 lbs. each, and in such a form as to provide a suitable *anode* for the electrolytic refinery. At this time it is 99½ per cent. pure copper. The slag is returned to the Reverberatory Furnace as in the preceding process.

REFINERY

On arrival at the *refinery* the *anodes* are sampled for analysis, heated at 350 deg. F., for 3 or 4 hours, so as to be thoroughly dried, weighed, and then introduced as anodes into an *electrolytic bath* of copper sulphate and sulphuric acid. At the same time a thin starting cathode is introduced, direct current passed and the copper is dissolved from the anode and re-deposited on the *cathode* as extremely pure copper. The precious metals do not go over but settle out as "*anode slime*" which is removed from the tanks from time to time and taken to the *precious metal refining department.*

When the anodes become so thin as to create a danger of their breaking they are removed, re-melted, together with any defective or broken new anodes, in the Refinery's Anode Furnace and re-cast to the original size. In the meantime the *cathodes* are removed, washed, packed and eventually re-melted in the *wire bar furnace*, where "poling" again is necessary to keep the copper oxide to the proper percentage. The copper then is cast into electrolytic wire *bars*, *billets*, *ingots*, *cakes* or *slabs*. The product in which we are interested is the electrolytic wire bar which is usually around 250 to 275 lbs., being 54 ins. in length with a cross section of about 4 in. each way, but slightly tapered toward the bottom.

It should be pointed out that all copper is not necessarily electrolytically refined. "Fire Refined" copper also is produced and indeed a recent large refinery installed in England is of that type. Both Canadian refineries are, however, electrolytic.

### ROD MILL

The principle of any rolling mill is, as you probably know, that of squeezing the bar between notched heavy steel rolls so as to reduce its cross section at each pass and at the same time "work" it by changing its cross section from square to rectangular, to oval, to round, to flat, to square and so on in a well planned scheme to develop the best grain structure possible. Like most metals, proper working is essential to bring out the best mechanical characteristics of copper.

The *billet furnace* is for the purpose of heating the wire bars to a temperature of about 1780 degrees F. The furnace is 36 ft. long by 10 ft. wide, oil fired, the bars being entered at one end and pushed along a pair of rails, emerging at the other end at the desired temperature and ready for the rolling process itself.

The *roughing rolls*, one stand, three rolls high, take the shock of the first heavy reductions in cross section. The bar makes five passes backward and forward through the roughing stand, the first pass lengthening it to about 8 ft., and by the time it has made the fifth pass through the rolls it is about 50 ft. long. During this phase the rod is handled completely by machinery as it passes backward and forward through the rolls. It is then ready for delivery to the intermediate train.

The *intermediate train* consists of five stands side by side, each two rolls high, the rod passing once through each pair of rolls.

On one side of these rolls the rods are passed from one roll to the next by means of automatic repeaters, which are merely guide channels, on the other side by "stickers", that is manually. On each side of these intermediate and finishing stands there are "looping pits" which receive the excess rod since each stand delivers the rod more quickly than it is taken up by the succeeding stand.

The *finishing rolls* are similar to the intermediate rolls. There are four stands each two rolls high of which all or none may be used, depending on the final size of rod desired.

The operation of "sticking" particularly on the finishing rolls, where the speed of the rod may be up to 1,300 ft. per minute (22 ft. per second) requires the highest type of skill, combined with physical strength and endurance. A first-class sticker is a treat to watch. At first glance it appears ridiculously easy, an appearance due to the perfect timing and the grace of the swing as he utilizes the momentum of the rod to assist him in swinging around to enter it in the next roll. It is one of the most fascinating operations in the whole copper industry.

The product of a rolling operation is known as a "*rod*", although it appears very much like a wire as it lies in a coil.

As the rod emerges from the finishing roll it is guided through a pipe into the *coilers*, which are mounted on ball bearings set in the floor, is coiled and passed on a conveyor through a cooling water bath known as a "*bosh tank*". The rod, on cooling, is black due to its coating of oxide formed during its exposure to the air while hot.

Rods for export are shipped "black", the oxide acting as a protection against the sea air.

Rods for domestic consumption are treated with diluted sulphuric acid in the *pickling tanks* to remove the copper oxide.

The *rinsing tanks* employ hot water to remove the acid (hot water being used to ensure that the rods will dry completely on being removed) and are then ready for shipment from the rod mill to the wire mill.

WIRE MILL

The next step in the preparation of copper for wires and cables (for lack of time and lack of familiarity the other important processing of copper, heavy bar sections, tubes, sheets, etc., etc., are not covered) is the wire drawing process. The principle of wire drawing is that the cleaned copper rod is tapered at the end, this end threaded into a die (usually a circular opening smaller than the rod diameter in an annular piece of chilled iron, special steel alloy, or, for fine wire industrial diamond) the end seized and the whole rod pulled through the die. Pickling and Rinsing Tanks are shown in the wire mill in the chart but are only used if the rods are oxidized or tarnished after leaving the rod mill, which frequently is some distance from the wire mill. The product of a drawing operation is known as a "wire". Each die reduces the wire diameter by approximately one Brown & Sharpe Gauge size although this is a very broad generalization and not accurate in detail.

Wire drawing machines may draw one pass at a time (usually employed in very large sizes only) or varying numbers of dies up to twenty-four may be arranged in series in the one machine, each die smaller than the preceding one. The wire in such machines runs in a soaplike solution which acts as a lubricant. When it is desired to splice rods or wires while drawing hard silver solder is the general method.

The process of drawing tempers the copper and renders it "hard drawn" increasing its strength very substantially but making it much less ductile. Accordingly it is necessary at intervals to anneal the wire, which is done by heating to about 1050 deg. F., for one-half hour, while air is rigidly excluded. *Annealing furnaces* may be coal, oil or gas fired, or electrically heated, depending on relative fuel costs.

It should be noted that the term "*soft drawn*" is a misnomer, wire always being hardened by the drawing process. *Medium hard drawn* copper is annealed copper which has been given one or two passes after annealing.

It will be noted there are four general classifications of drawing machines. The wire from any one of these types may be shipped out in that form, sent to the insulating departments, sent to the stranders, or sent to the annealing furnaces. Also wire from the annealing furnaces may be shipped out in that form, sent to the insulating departments, sent to the tinning furnaces, sent to the stranders, or sent to the next size of drawing machine and drawn down further.

The approximate range of sizes for each class of drawing machine is as follows. This is subject to considerable variation from factory conditions, raw materials and purpose of the product.

| Machine | From | To |
|---|---|---|
| Draw Benches | 1 in. to ¼ in. Rods | .100 in. wire and Intermediate Sizes |
| Heavy Drawing Machines | 5/16 in. Rods to .100 in. Wire | .040 in. Wire and Intermediate Sizes |
| Intermediate Machines | .128 in. to .100 in. Wire | .015 in. Wire and Intermediate Sizes |
| Fine Wire Machines | .035 in. to .010 in. | .002 in. Wire and Intermediate Sizes |

The finest wire, literally, is finer than the hair on your head.

Wire from the *tinning furnaces* may be shipped out in that form, sent to the insulating departments or sent to the stranders. The product of the stranders may be shipped out in that form, or sent to the insulating department.

At the *tinning furnace* the wire is run through an acid flux, wiped, through a bath of molten tin, wiped, through a water cooling bath and then to the take-up reels. Tinning is usually resorted to for the purpose of providing a protective coating over the copper against the action of sulphur in rubber compounds.

In the *stranders*, of which there are several types, the cross sectional area of the copper is increased by winding together a number of individual wires. You will have noticed that, up to this point, the area of the copper has been reduced successively. If larger areas of copper, without sacrificing flexibility, are desired the stranding operation is resorted to.

In "Bunched" Strand (used only for fine sizes) the individual wires are twisted together without extreme care being taken in their arrangement. The usual stranding, however, is built up on the principle that when drawing a series of equal circles fitted together in the closest possible manner it will be observed that the centres of these circles are arranged in concentric circles and that each layer of the original circles contains six more than the layer immediately beneath it. Thus with one wire at the centre we strand six around it to make a "seven wire strand" twelve around that to make a "nineteen wire strand" and so on. The overall diameters go up as one, three, five and so on.

Such a cable (the product of a stranding operation is generally known as a "Cable" at least in the larger sizes) is known as "Concentric Lay". Typical concentric lay cables are 7, 19, 37, 61, 91, 127; 3, 12, 27 and so on. A "Rope-Lay Cable" is one in which a number of concentric laid elements are themselves stranded together concentrically to result in such stranding as 7/7, 19/7, 37/7, 7/19, 7/37 and so on.

### Insulating Processes

Times does not permit of the insulating processes being described, even in a sketchy way. However

Fig. 7 is shown as a general guide to anyone interested.

### Statistical

Copper's present outlets are largely toward the electrical industry, figures for 1929 for the United States indicating their domestic consumption of manufactured copper to have been subdivided as shown in Table No. 2.[6]

TABLE NO. 2

| | |
|---|---|
| Wire and Rod, etc. | 59.2% |
| Sheet Strip, etc. | 15.8% |
| Tube | 4.6% |
| Miscellaneous | 0.4% |
| Brass (and Other Alloys) Sheets (Copper Content) | 9.0% |
| Brass (and Other Alloys) Rod and Wire (Copper Content) | 5.0% |
| Brass (and Other Alloys) Tube (Copper Content) | 4.0% |
| Brass (and Other Alloys) Misc. (Copper Content) | 2.0% |
| | 100.0% |

We may assume that practically all of the first item, and part of the second and sixth are for electrical purposes so that substantially over sixty per cent. of copper consumption is dependent on the electrical industry, the situation in the U.S. being taken as representative.

However, there has been increasing appreciation during the past three or four years of the inherent value of such a permanent metal as copper in the building industry. It has long been the "de luxe" roofing and plumbing material for important public buildings where permanence and beauty were determining factors. Now, the ruling low price of copper and more particularly the development of lower cost methods of installation are bringing copper more and more within reach of the average homebuilder. An outstanding instance of this is that hard copper pipe for plumbing, due to a recently developed type of easily soldered fitting has been put on a competitive basis with iron pipe. Since the fittings and joints are soldered there is no necessity for weakening the pipe by cutting threads, hence relatively thin walls may be used with at the same time an increased factor of safety. This, with the greater ease of installation, permits the use of a non-rusting permanent copper pipe in place of iron pipe. For years copper pipe for building purposes in the United States was about 1.2 per cent. of the iron pipe used for the same purposes. During the past two years this has arisen to 2.8 per cent. and is still increasing. It would appear that an important new outlet for copper has been opened.

It is estimated that prior to 1800 the total production of copper did not exceed 1,000,000 tons[7]. A study of Table No. 3, shows its annual consumption for representative years since that time. It will be recognized how these increases coincide with the period of growth of the use of electricity. In the same table the rise of the Canadian Copper Industry during the past five years is strikingly shown. The last item, for last October, is shown chiefly to illustrate the really important position that Canada is assuming in world production, a part largely due to the very aggres-

TABLE NO. 3

Copper Production—Short Tons

| Year | Canada | World | Canada Per cent. of Total |
|---|---|---|---|
| 1800 | ...... | 91,000 | ...... |
| 1840 | ...... | 291,000 | ...... |
| 1895 | 5,800 | 332,182 | 1.75% |
| 1900 | 10,400 | 486,600 | 2.14% |
| 1905 | 22,815 | 689,784 | 3.3% |
| 1910 | 26,350 | 861,109 | 3.06% |
| 1915 | 46,456 | 1,050,276 | 4.42% |
| 1927 | 35,613 | 1,682,361 | 2.12% |
| 1929 | 124,060 (8) | 2,127,834 (6) | 5.83% |
| 1930 | 151,737 (8) | 1,749,598 (6) | 8.68% |
| 1931 | 146,152 (8) | 1,501,486 (6) | 9.73% |
| October, 1933[8] | 14,870 (8) | 97,000 | 15.32% |

sive attitude of our large producers in developing the Empire market.

The present estimated world stocks of refined copper are 640,000 short tons[9], i.e., less than seven months' supply. When one considers that most of these stocks are in the U.S.A. the stocks overhanging the copper market are not at all discouraging from the view point of the copper producer.

The average U.S. price for copper for the 87 years, 1845-1931, was 16.1 cents and for the 30 years, 1902-31 inclusive, 16.3 cents. The corresponding prices for recent years were as listed in Table No. 4.

TABLE NO. 4

Average U.S. Copper Prices (Refinery)

| | | | |
|---|---|---|---|
| 1928 | — 14.62 | cents | (10) |
| 1929 | — 18.17 | " | (10) |
| 1930 | — 13.0 | " | (10) |
| 1931 | — 9.1 | " | (10) |
| 1932 | — 6.3 | " | (10) |
| October 1933 | — 7.557 | " | (8) |

TABLE NO. 5

Mineral Production in Canada.[11]

1931

| | |
|---|---|
| Gold | $55,395,000 |
| Coal | 41,320,000 |
| Copper | 23,772,000 |
| Nickel | 14,697,000 |
| Other Minerals | 22,000,000 |

An illustration of the importance of copper to Canada is supplied by Table No. 5.

We are familiar with the importance of gold to Canadians, it being the most spectacular of our minerals. It will be seen that in 1931 our copper production amounted to nearly $24,000,000 or about 40 per cent. of that of gold. Until recently we imported practically all of our copper. The Canadian Copper industry has now completely altered the picture. Our domestically consumed copper is now produced in all processes in Canada

and about four times as much exported as well. We are now the third largest copper exporting country in the world. What this means toward employment conditions in Canada is left to the economists but it must be highly important.

In conclusion the writer wishes to express his appreciation to Mr. W. C. Burch, for his suggestions and constructive criticisms.

REFERENCES

[1] A.S.T.M. Spec. B1-27.

[2] A.S.T.M. Spec. B3-27.

[3] U.S. Bureau of Standards Circular No. 73

[4] Smithsonian Tables.

[5] L. Addicks—Effect of Impurities on the Electrical Conductivity of Copper—Transactions of American Institute of Mining Engineers, Vol. 36, Page 18, 1905.

[6] Copper—H. F. Bain and W. G. Schneider (Copper & Brass Research Assoc.).

[7] C. E. Julihn—U.S. Bureau of Mines Economic Bulletin No. 1.

[8] Dominion Bureau of Statistics; Mining, Metallurgical and Chemical Branch, Circular M3-11-12-33.

[9] The Mining Analyst—Dec. 16, 1933.

[10] U.S. Bureau of Mines—Copper, 1932-33, C. E. Julihn & H. M. Meyer.

[11] Canadian Economic Research Bureau—July 20, 1932.

*Tecumseh Road, Windsor, Ont.*

# Domestic Load Possibilities

By H. C. Powell, Statistician, Toronto Hydro-Electric System

*(Presented to Association of Municipal Electrical Utilities at Toronto, February 1, 1934).*

PURPOSE:

1, To show the immense possibilities for increase in domestic loads and revenues in Ontario.

2. To urge the utility commissioners, managers and employees to adopt an energetic policy of merchandising and servicing, and to carry out an intensive training programme covering all employees.

This paper is divided into three sections:—I, The Present. II, The Future. III, Load Building References.

I. THE PRESENT:

An analysis of conditions and statistics of a number of utilities reveals at least seven main facts, as follows:

1A. *Small consumption in Ontario.*

A very large percentage of the domestic consumers in each municipality are using very small amounts of electricity.

TABLE 1

KILOWATT-HOURS USED PER YEAR, PER CENT. OF TOTAL CONSUMERS, AVERAGES OF A NUMBER OF UTILITIES

30% use less than 600
30% use 600 to 1,200.
15% use 1,200 to 1,800.
10% use 1,800 to 3,000.
10% use 3,000 to 5,400.
5% use over 5,400.
100%
75% use less than 1,800.

Some utilities have as many as 95 per cent. who use less than 1,800 kw-hr. per year.

1B. *Average consumption in Ontario.*

The published average monthly consumption of domestic service, as shown in H.E.P.C. Annual reports, does not indicate how many consumers use less than the average. The monthly figures have been converted into year figures for Table 2.

TABLE 2

AVERAGE YEARLY CONSUMPTION, KILOWATT-HOURS PER YEAR, BASED ON H.E.P.C. ANNUAL REPORTS.

| Year | Cities Kw-hr. | Towns Kw-hr. | Villages Kw-hr. |
|---|---|---|---|
| 1914 | 262 | 209 | 157 |
| 1920 | 581 | 432 | 254 |
| 1925 | 1,164 | 966 | 564 |
| 1929 | 1,646 | 1,174 | 806 |
| 1931 | 1,780 | 1,297 | 941 |
| 1932 | 1,834 | 1,290 | 1,004 |

1C. *Average consumption in Winnipeg*

The City of Winnipeg Hydro-Electric System states:—1, that their 1932 yearly average of 4,321 kilowatt-hours per domestic consumer was the highest yearly average in the world; 2, that this growth is the product of attractive rates, promotional campaigns, and sustained sales effort.

2. *Consumption below the average.*

Though Table 2 shows a remarkable growth in Ontario in 18 years, yet the startling fact is that almost 90 per cent. of the consumers use less than the published averages.

3. *Consumption above the average.*

Among the 10 per cent. of consumers who use more than the published averages, are a large number of 6 and 7 room houses using 12,000 to 18,000 kw-hr. per year, also some larger houses using considerably over 24,000 kw-hr. per year.

4. *Consumption for full-use electric home.*

Over 75 per cent. of the families of urban communities in Ontario come within the income group of $1,500 or less per annum, the average annual income of this group being not over $1,100, even in prosperous times. Studies of typical families of this group, who have full-use electric homes, have averages of kw-hr. per year and of first cost of the appliances, as shown in Table 3.

TABLE 3

Averages for Full-use Electric Home in Families Whose Annual Income is Less than $1,500.

| Appliance | Kw-hr. per year | First Cost |
|---|---|---|
| Range | 1,440 | $100.00 |
| Refrigerator | 720 | 150.00 |
| Water heater | 3,000 | ..... |
| Iron | 48 | 4.50 |
| Toaster | 36 | 4.50 |
| Washer | 36 | 90.00 |
| Vac. | 36 | 65.00 |
| Radio | 60 | 80.00 |
| Blower | 180 | 75.00 |
| Other Devices | 84 | 105.00 |
| Lighting | 360 | 96.00 |
| Extra Wiring | ... | 80.00 |
| Totals | 6,000 | $850.00 |

If some families of low income are ambitious enough to have full-use electric homes, you can see the marvellous load-building possibilities by persuading other families to do so.

Families of larger income use greater kw-hr. per year and purchase appliances of higher price.

5. *Reasons for lack of appliances.*

The main reasons as given by consumers are:—

1. New homes are not adequately wired.
2. Older homes are not being rewired, particularly in rented houses.
3. Wiring costs too high.
4. Appliance costs too high.
5. The period of installments is too short. The extra cost for installments is too high.
6. Not sufficient education, demonstration, nor persuasion to buy.

6. *Appliances not in use.*

Employees, whose duties require going inside consumer's homes, find many appliances not in use. Some of the reasons for not being in use are as follows:—1, Needing repairs. 2, Not working satisfactorily. 3, Not up-to-date. 4, Apparently worn out. 5, Not fulfilling salesman's promises. 6, Poor design or defective workmanship.

Some employees, who take an interest in advising the consumer, succeed in placing many appliances again in use. Consumers are frequently persuaded either to have appliances repaired, or to buy more up-to-date devices. A whole paper on this subject alone, could be written to demonstrate the immense possibilities of load building, either by keeping appliances in service, or by replacing with new equipment.

7. *Education and training are inadequate.*

(a) The commissioners (over 900) of Ontario utilities should be boosters and merchandisers. As they are leading citizens of their respective communities, their trained leadership would have great possibilities.

(b) Utility managers should supply initiative and leadership in plans, ideas, education, campaigns, and community co-operation. What a wonderful movement can be created and developed by over 300 live, energetic, merchandising managers.

(c) Though heads of departments, supervisors, foremen, and those in charge of others, have their individual responsibilities, yet they, together with their employees, have great possibilities and many opportunities for a movement of education and load building, if given proper training and direction.

(d) Government records show that Ontario has 6,400 employees in publicly owned electrical utilities, and 1,100 in privately owned. The electrical industry, exclusive of electrical utilities, employ over 10,000 people. Counting all connected with the electrical industry in Ontario, including commissioners, the total is over 18,400 who are directly employed. Add at least two other members of each employee's family, who also could be trained as boosters, we than have an army of over 55,000 available, waiting for education and training.

(e) It is not the purpose here to list cases where consumers receive unsatisfactory treatment from employees of utilities. Every manager receives complaints of many kinds. So many employees seem to make statements to consumers either without thinking, without proper investigation, without adequate knowledge of the subject, or without realizing that some other person or department is qualified and authorized to handle the case. They should be trained at least as to what *not* to say.

## II. The Future

A number of ideas are here set forth to stimulate thought and discussion for commissioners, utility managers and employees.

1. *The long look ahead.*

You should plan for the next 25 years. World-wide depressions occur about every 18 years and usually last about four or five years. A 55 year economic cycle seems to be repeating itself true to form, regardless of social or political changes. Commodity prices were highest in 1810, 1865, 1920, and the next high is expected in 1975. Bottom prices occurred in 1840's, 1890's, the next bottom prices are expected in 1950's. The highest average is about four times that of the lowest average. Prices are expected to be on the down grade from 1938 to 1953. The next severe depression is expected 1948 to 1953 which may be similar in severity to those of 1893-98 and 1837-44, due to prices being at the bottom. The depression of 1929-34 was similar to those of 1873-78 and 1818-24 when prices were on the down grade. The latter type of depression is not quite so serious as the former. There is still a third type of depression, not nearly so serious as the other two, which occurs when prices are rising, 1857-61, 1912-16, and the next in that group is expected 1967-71.

Though forecasts are many and varied, yet the following outlook seems to have many supporters because it is based on experience of the last two hundred years. Good prosperity 1935 to 1939; minor depression 1940 and 1941; fair prosperity 1942 to 1945; gradual falling off 1946 to 1948; very serious depression, 1948 to 1953; gradual up turn 1954 to 1959. After 1959 the period is expected to be somewhat similar to that which followed 1904.

A number of books published recently are extremely pessimistic of the 1950's. H. G. Wells in "The shape of things to come", calls that period the "famished fifties" and predicts that 1,000,000,000 people (half the world's population) at that time will die during disease epidemics.

Be that as it may, it behooves all utility managers to prepare in advance for the time when revenues will be greatly reduced within 15 to 20 years from now. Be prepared to reduce costs, retire debentures, build up reserves. When all kinds of prices are down, there may be a demand for reduced rates. It is expected that uncollectible accounts will be quite large because many people will be unable to pay their bills.

Experience shows that domestic loads and revenues have held up in depression times proportionately more than power or commercial lighting.

2. *Low monthly cost plan.*

A great need exists for a plan whereby the low income consumer may obtain the benefits of electrical conveniences on the basis of low monthly payments to cover the cost of everything,—(a) cost of wiring; (b) cost of appliances; (c) cost of financing; (d) cost of servicing and repairs; (e) cost of current.

As a starting point for discussion, the yearly sum of $150 would take care of everything for a full-use electric home as follows: (a) current, 6,000 kw-hr. at 1.2 cents per kw-hr. = $72.00 per year, or an average of $6.00 per month; (b) equipment installments, $78.00 per year, an average of $6.50 per month. This will provide a full-use electric home within about 9 years.

3. *Low price appliances.*

The whole industry should co-operatively strive to reduce the costs of wiring, of appliances and equipment, of servicing and repairs, of financing the installments, so that the price may be within reasonable reach of the low income consumer.

There would be plenty of opportunity among larger income families, to sell higher priced equipment and more extensive wiring.

4. *Heavier branch circuits.*

There is an urgent need now for 30 ampere branch circuits instead of 15 ampere. Consumers are buying and using 30 ampere fuses, so why not design the circuits for heavy duty. The entire house wiring system should be redesigned to provide for heavy loads in every room and for remote off peak control of certain loads.

5. *Load remote control.*

The whole industry should co-operate in inventing and developing a system of load remote control covering the whole territory of every municipality, entering every service, and controlling many kinds of equipment in both domestic and commercial installations. For example—flat-rate

water heaters; metered water heaters; refrigerators; air conditioning; oil burners, or coal blowers; air heaters, grates, etc.; fans; signs; street lighting; public or private lighting; pumping; industrial heating; electric steam boilers; and many other industrial applications.

6. *Demand limit device.*

Though this idea has been suggested before, yet it should be repeated, that there is a need for some method of keeping the house maximum demand within predetermined limits without causing inconvenience to the people or processes in the house. This would prevent abnormal demands on the system.

7. *Training employees.*

The training programme for employees should be in three parts; 1, job training; 2, consumer relations; 3, electrical appliances and merchandising. Each utility manager can train his employees into a marvellous organization to do the following:—

1. Give correct information in a courteous manner.
2. Discuss electrical appliances with consumers, friends, acquaintances, anytime anywhere. Use appliances in their own homes.
3. Supply prospects to the sales staff.
4. Make sales through their own efforts.

The women employees have considerable talent for giving demonstrations of appliances and home service to groups of women of the community.

8. *Co-operative Selling.*

New things can not be sold until demand is created. This requires money, skilled advertising, well-trained sales people, specialty selling, expensive demonstrations. It is vital for the whole industry to co-operate in a province-wide policy with local organizations in each community for market study, promotion, saleswork, purchasing, sales, financing, warehousing, servicing, installing, repairing, etc. Profit for all is necessary, including good salaries and commissions for salespeople. The utilities should do everything possible to assist these co-operative measures, and take the leading part in their respective communities.

9. *First Class Service.*

No sales campaign is a success unless the customer is satisfied and kept satisfied. The following is a summary of some things necessary to give satisfaction. 1. Continuous service. 2. Steady voltage. 3. Adjust complaints quickly and courteously. 4. Attend to repairs and trouble calls promptly. 5. Study each case carefully to find the cause, find a remedy, and provide suitable instructions for employees. 6. Send someone to the home to explain the use and operation of appliances. 7. Keep appliances in operation, check up to find defective appliances whenever a call is made, keep up a steady campaign for repairs. 8. Sell only first class appliances. 9. Give liberal allowances for old appliances. 10. Supply courteous service and information so far as it is economically possible.

III. LOAD BUILDING REFERENCES

The Merchandising Committee of the A.M.E.U. makes recommendations from time to time, all of which are worthy of careful consideration

and of early putting into practice. The following groups of references are supplemental to those of the Merchandising Committee, and are intended as a guide for anyone who desires to know where to find material in the magazines for further study.

1. *Adequate Wiring.*

An example of successful co-operation of the whole industry is the Toronto Electric Service League, 1 Hayter St., Toronto, which originated the Red Seal Plan for Adequate Wiring. This plan and this type of organization has been adopted and highly commended both in Canada and in United States. See their annual report of 1932; and Electrical News, Mar. 1, 1933, page 27.

2. *Load Building—General.*

(a) Special load building issue of Electrical News, June 15, 1932, describes the policies of Canadian utilities; Southern Canada Power Co.; B.C. Electric Railway Co.; Shawinigan Co.; Canada Electric Co., Amherst, N.S.; Gatineau Power Co.; Toronto Hydro-Electric System; Montreal L.H. & P. Co.; Calgary; Winnipeg Elec. Co.

(b) "Central Station's new responsibility", by G. W. Austin; H.E.P.C. Bulletin, Feb. 1933, p. 53; "Making more use", by J. Showalter, H.E.P.C. Bulletin, Feb. 1933, p. 58.

(c) "How to sell homes", by H. P. Liversidge, Electrical World, Nov. 25, 1933, p. 697. "Sales—more volume and more profit," by L. W. W. Morrow, Elec. World, Nov. 18, 1933, p. 659.

(d) Several editorials in Electrical News, Feb. 15, 1932, p. 42; Mar. 1, 1932, p. 29; Dec. 15, 1932, p. 36; Jan. 15, 1933, p. 27.

(e) Reports of Canadian Electrical Association committees on Merchandising and Wiring Sales; Elec. News, July 1, 1932, pages 28 and 31.

(f) "Better Public Relations", by H. M. Sawyer; El. News, Nov. 1, 1933, p. 19. This describes a house to house canvas.

3. *Ranges and Cooking.*

(a) Range Rentals in England; Elec. World, Jan. 21, 1933, p. 81; Elec. World, Nov. 18, 1933, p. 664.

(b) Trial Range plan in Hartford; Elec. World, Oct. 28, 1933, p. 565; Elec. Merchandising, Sept. 1933, p. 30.

(c) Range rental plan of Central Maine; Elec. World, Nov. 11, 1933, p. 625.

(d) Cookery Council, Mohawk Hudson; Elec. Merch., July, 1933, p. 15.

(e) Cookery Council, Metropolitan Edison; Elec. Merch., Aug., 1933, p. 16.

(f) Cooperative plan, Central Hudson, Elec. World, Aug. 12, 1933, p. 213.

4. *Water heating.*

(a) Free water heaters. H.E.P.C. Plan; Electrical News, April, 1933, p. 15.

(b) Winnipeg plan; Elec. News. May 1, 1933, p. 29.

(c) B.C. Electric Ry. Plan; Elec. News, April 1, 1933, p. 17.

5. *Financing.*

(a) Virginia plan using Morris banks; Elec. World, July 8, 1933, p. 57.

(b) Finance house; Elec. Merch., Feb., 1933, p. 38.

(c) Philadelphia plan, Elec. Merch. March, 1933, p. 36.

(d) Commonwealth Edison plan; Elec. Merch., April, 1933, p. 38.

(e) Brockton plan; Elec. Merch., June, 1933, p. 40.

6. *Employees bonus.*

Tip bonus plan, Colorado; Elec. Merch., April, 1933, p. 31.

NOTE:—Space does not permit other references in various magazines.

## James A. Harris, Toronto

*James Arthur Harris*

All who knew James A. Harris, Assistant Manager of the Power Department, Toronto Hydro-Electric System, will regret his sudden passing from our midst on February 8, 1934.

Due to his connection with the Toronto Hydro-Electric System, and previously with the Toronto Niagara Power Company, he had many friends in the commercial and industrial life of Toronto and also in the Hydro Utilities in the Province of Ontario.

A member of the Electric Club of Toronto for many years, he held the office of Secretary to the Club for some time and more recently was a member of the Executive Committee. For two years he was active on the Executive Committee of the American Society for Steel Treating, and at the time of his death was Chief Ranger of Court Loch Lomond of the Independent Order of Foresters and a member of the York Masonic Lodge.

Born in Brighton, England in 1886, he received his schooling and special training in electrical work in that country, coming to Toronto in 1906. He secured employment with the Toronto Electric Light Company, holding various positions with that Company until October, 1915, when he joined the Canadian Expeditionary Force. Serving in France until early in 1918, he was invalided back to Canada, holding at the time of his discharge from active service, the rank of Captain. When in 1922 the Toronto Niagara Power Company was taken over by the Hydro-Electric Power Commission, he began his association with the Toronto Hydro-Electric System which continued until the time of his death.

His genial nature and happy disposition left an impression on all those with whom he came in contact. He entered whole-heartedly into any scheme whereby good fellowship would be promoted.

He is survived by his widow, two daughters and a brother all resident in Toronto, as well as two brothers resident in England.

A largely attended funeral gave evidence of the high esteem in which "Jim" was held in the community and among his fellow workers.

—W. J. W.

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


## Mary Grant, London Township

MISS Mary Grant, Clerk of the Township of London since 1900, and Secretary of London Township Hydro-Electric System, died in St. Joseph's Hospital, London, on Monday, March 5th, 1934.

As one of the most highly esteemed municipal officials in Canada, Miss Grant was widely known. During her long period of service, her counsel on municipal affairs was sought by ratepayers, reeves, councillors, assessors, and many other Western Ontario residents.

Miss Grant was believed to be the first woman in Canada ever to hold the office of clerk and treasurer of a municipality.

Her passing will be widely mourned, for Miss Grant had a personal interest in every family residing in her township, noting the achievements of any natives of London township, and referring to the sons and daughters of the township as "our boys" and "our girls".

She was a pioneer in the movement to introduce Hydro to the rural districts of Western Ontario. In her many addresses in various localities, she emphasized the benefits to be derived from Hydro by the farmers' wives. Realizing that the country woman has innumerable duties to perform, she was eager to see the labour saving devices installed in every rural home.

*Miss Mary Grant*

## CONTENTS

**Vol. XXI** **No. 3**

**MARCH, 1934**



Her knowledge of the people, not only in London Township, but also in the other townships adjacent to London, made her assistance invaluable when Hydro rural service was being established in that area. She was an enthusiastic member of the Ontario Municipal Electric Association and a regular attendant at its meetings. She was also Vice-President of the Ontario Municipal Association during the early twenties.

## D. R. Brockbank, Paris Honoured

*David R. Brockbank*

We congratulate David R. Brockbank, Superintendent of the Paris Public Utilities Commission, on having completed thirty-five years of continuous service with the public utilities of that town. On December 15th, 1898, Mr. Brockbank joined the staff of the Waterworks Department of the Town of Paris, where he advanced to the post of Superintendent, and later was also made Superintendent of the electric utility. When the Paris Public Utilities Commission was formed, controlling both water and electric departments, he was retained as Superintendent, which office he continues to hold.

The completion of thirty-five years' service was made the occasion for a function arranged by the Paris Public Utilities Commission, and held in the Council Chambers. An address of appreciation was presented to Mr. Brockbank, which was signed by the members of the Utilities Commission, and Mrs. Brockbank was presented with a bouquet of roses. In reply, on behalf of Mrs. Brockbank and himself, Mr. Brockbank expressed appreciation of the honour done them.

Following the presentation there were complimentary addresses by a number of prominent citizens.

# Statements

### By Chairman, The Honourable J. R. Cooke
### And by Mr. C. Alfred Maguire.

TWO statements of importance to all interested in the work of the Hydro-Electric Power Commission of Ontario recently appeared in the public press. The first statement was issued by Mr. C. A. Maguire and appeared in the daily papers of February 15th, 1934, when, in response to request, Mr. Maguire gave a fuller explanation of some observations he had made in the course of an address delivered at the meeting of the Ontario Municipal Electric Association held in Toronto on January 31st, 1934. The second statement as issued by Hon. J. R. Cooke, on March 16th, 1934, corrects a misunderstanding that had arisen respecting some comments made in a public address given by the Commission's Chief Engineer, Mr. F. A. Gaby, before the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities, at Ottawa, June 26th, 1931. These statements are here published for purpose of reference. They speak for themselves and are as follows:

---

## Statement by C. Alfred Maguire

**President, Ontario Municipal Electric Association**

I HAVE been urged to present a statement in fuller explanation of some observations I made in the course of my address at the recent meeting of the Ontario Municipal Electric Association, when I issued a warning to the members to continue to be on guard against the operations of those who are avowedly opposed to the principles upon which the co-operative hydro-electric undertaking of the municipalities of the Province of Ontario is founded. It may truly be said that Ontario's Hydro undertaking is really never free from influences that menace its welfare, and many of these influences are of a subtle and more or less concealed character, and consequently are not always early discernible by those whose work does not bring them into more immediate relationship with such activities.

Ontario's Hydro undertaking has perhaps had no more unscrupulous attacks directed against it than those that have been sponsored or aided by the *National Electric Light Association* which is recognized as the representative of privately-owned power utilities of the United States and Canada,—and which has quite recently been renamed the *Edison Electric Institute.*

It has been brought out at Hearings before the Senate Investigating Commission at Washington, D.C., that the advertising budget of utilities in the United States would approximate $25,000,000 to $30,000,000 annually,—a figure which suggests the colossal amount of money available for such purpose. It makes no difference whether this figure is precisely correct or not; it is at least indicative of magnitude. Special funds have been available for special purposes, such

as for watching and influencing national legislation at Washington affecting utilities. According to representations publicly made respecting the levy upon members of the electrical utilities' organization referred to, there would be $1,500,000 annually available for the purpose of this propaganda body.

In the past, when attacks upon our Hydro undertaking have been made, they have been disguised under the representation that they were disinterested studies, and it was not found out until some time afterwards what large financial contributions were made by the National Electric Light Association interests to support and further anti-Hydro propaganda. Subsidies paid to college professors, educational and publicity men and radio publicity were disguised under misleading headings, such as "contingent" funds, "regular" funds, "outside the regular budget" funds; alleged "good-will" advertising has been termed "insurance", while payments aggregating about six thousand dollars to a college professor and upon a motion picture account were labelled on the voucher as "engineering investigation on wind and ice loading of transmission lines". Even payments made by the National Electric Light Association to our Canadian Professor Mavor were not entered under his name but as payments to a "mutual friend".

It was brought out in the Hearings at Washington, D.C., that one of the integral units of the organization referred to operates in Canada. When one of the National Electric Light Association publications attacking the Hydro—a large volume of more than 200 quarto pages—was issued in English, it was also translated into the French language and copies were distributed in Canada.

Without getting into any detailed review of the circumstances at the recent meeting of municipal delegates and counting upon the fact that many of our members—especially those who were not newcomers to the Association—were more or less familiar with some of the operations of the National Electric Light Association, I felt it necessary to again warn our members to be on guard, especially as I am convinced that there is still great need to protect our Hydro undertaking against such operations as characterize the organization to which special reference was made.

After the disclosures made by the United States Federal authorities appointed to investigate the operations of the National Electric Light Association and other trade organizations, the National Electric Light Association apparently found it advantageous to change its name to the "Edison Electric Institute". It has been appreciated that this is simply a new name for the former operators and that the leopard does not, overnight, change its spots or its methods of attack, and therefore I issued my warning.

As showing that I am not alone in recognizing the need to be on the alert and if necessary on the defensive, I quote from a recent statement made in a public hearing in Washington, D.C., by Hon. Henry T. Hunt, General Counsel for President Roosevelt's Federal Administration of Public Works, when he charged that the Edison Electric Institute was virtu-

ally carrying on where the discredited National Electric Light Association had left off. He described the Edison Electric Institute as an unsocial "agency to further despoil the American people through exorbitant rates, nefarious financial practices and misguidance of public opinion pursuant to the policies of the malodorous National Electric Light Association. The snow-white vesture of members of the Institute in no wise alters the character and objectives of the sinister forces within it".

Even with regard to Major Bennion, Acting Managing Director of the Edison Electric Institute, commenting upon my reference to Professor Mavor's book, where he says that "the Canadian Professor wrote a book which the Association liked well enough to buy copies of the same", it is sufficient to point out that the Canadian press was definite in its condemnation of this Mavor book when it appeared about the time of its author's decease. The "Toronto Globe", for example, with reference to it stated editorially that:

> "The reputation of the late Professor Mavor as a writer of works of political economy has been most injuriously affected by the posthumous publication of what purports to be a history of "Niagara in Politics", but which is in reality a brief against the public ownership or operation of the water powers of Ontario, and all similar ventures into the fields of transportation and industry."
>
> "It may seem ungenerous to criticize the dead, but it is not less so that the dead should put into currency such amazing misrepresentations concerning the public men and the public life of the Province in which Professor Mavor had his home for a large part of his life, but of which in all essential respects—its beliefs, ideals and economic necessities—he appears to have remained ignorant to the end."

Major Bennion's reference to the Mavor book—as reported in the public press of February 3rd, 1934,—may be accepted as typical of the way in which the National Electric Light Association purported to represent the facts, and also demonstrates the fact that the Edison Electric Institute has not departed from these methods. Major Bennion gives no indication of the fact that Professor Mavor, according to the records of the public investigation at Washington, was actually subsidized by the National Electric Light Association with actual cash payments, nor is the fact brought out that literally thousands of copies of the Mavor book were purchased and distributed as propaganda.

As Major Bennion says, his organication "liked the book", and, of course, the obvious reason why they liked it was because it is a vicious attack upon Ontario's Hydro undertaking. Certainly, the organizations that admit a liking for such attacks are a positive menace to Ontario's Hydro undertaking.

From the disclosures that have more recently been made regarding the methods employed in anti-public ownership propaganda, and of disguising expenditures, and taking into consideration the possibility of these methods being pressed into service in the Province of Ontario, it seemed to me urgent to repeat my warning that

Hydro needs to be increasingly on guard. Major Bennion's statement asserting that the present budget of the Edison Electric Institute is small, is not sufficient warrant for any assumption that such activities have ceased or that expenditure may not still be made secretly. The warning that I issued is timely and one that I earnestly hope will be heeded, in the interests of safeguarding the great municipally-owned Hydro enterprise.

---

## Statement by Hon. J. R. Cooke

**Chairman, Hydro-Electric Power Commission**

IN the Legislature on Tuesday, March 13th—referring to a statement in which Mr. Hepburn had expressed the intention of bringing about Mr. F. A. Gaby's dismissal should the Liberal party be returned to power—the Hon. William Finlayson asked Hon. Harry Nixon if *he* would dismiss Mr. Gaby. The Hon. Harry Nixon is reported in the press as replying, "Do you know he issued a three-page pamphlet as an attack on Mr. Hepburn".

As Chairman of the Hydro-Electric Power Commission, I regard it as my duty and privilege to point out that there is no justification whatsoever for such a charge against our eminent Chief Engineer, or for the charge, as one press report has it, that he "gave three pages of his pamphlet to a personal attack on Mr. Hepburn".

The only occasion of which I am aware when Mr. Gaby has ever made public reference to Mr. Hepburn, was an incidental reference made in the course of his address of nearly three years ago to the Ontario Municipal Electric Association and Association of Municipal Electrical Utilities, at Ottawa, June 26, 1931.

Mr. Gaby's 1931 address contained an extensive review of technical and other historical data respecting the Commission's operations, and, after publication in The Bulletin, was reprinted from the same type, as a 43-page pamphlet. It is part of the regular duties of the Chief Engineer, as well as of the officers and technical staff of the Commission, to keep the municipalities properly informed upon the facts relating to the work of the Hydro undertaking. Obviously, it is essential to do so in a manner that ensures that those interested will be able to recognize the correct data, and distinguish them from various misrepresentative statements that throughout the Commission's history have, from time to time, been published.

In this address and towards the close, Mr. Gaby made a special reference to the comprehensive information given in the Commission's Annual Report and—purely as an incidental illustration of the necessity of basing representations on officially-published data—he cited some incorrect statements that Mr. Hepburn had just previously been reported as making.

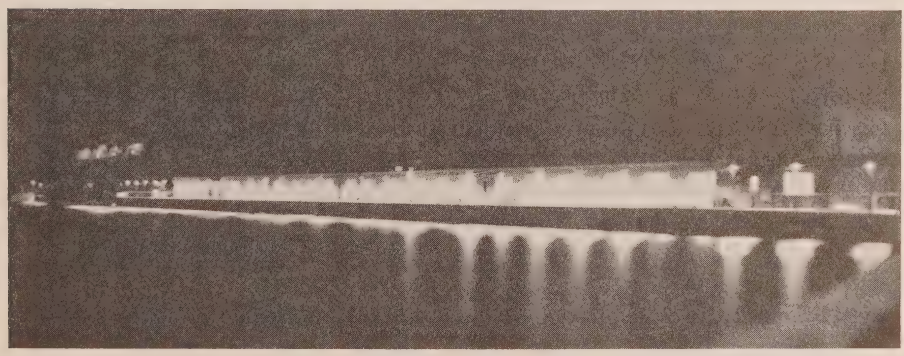
One very serious misstatement made by Mr. Hepburn in 1931 was that the Queenston-Chippawa development had cost $150,000,000; whereas the fact is that it actually cost less than $77,000,000 as recorded in the Annual Report of the Commission. Mr. Hepburn apparently had been misled by

taking his information from a publication specially prepared and issued in the United States and which avowed that its data were for use in connection with any "thorough-going anti-municipal ownership advertising campaign". Mr. Gaby used this incident to urge upon the assembled delegates the necessity of relying upon official published Reports of the Commission and in particular upon the Annual Report to which he was making specific reference

Mr. Gaby's 1931 address is in printed form so that anyone can refer to it, and I challenge anyone to show any place where Mr. Gaby has ever attempted "to attack Mr. Hepburn personally". The whole presentation is on a definitely impersonal basis—and just here I should like to add that although during his twenty-five years with the Commission, Mr. Gaby has had to make many public statements, I can recall no instance where he has dealt with any matter or with any individual, upon a personal basis.

Mr. Hepburn's name was simply referred to because it was essential to identify the representations that had been publicly made, but there were no personal criticisms whatever in the whole address. The portion of the reprint in which Mr. Hepburn's name is mentioned covered less than two pages out of the 43-page reprint as issued.

About the time when Mr. Gaby's address was being prepared, Mr. Hepburn's statements respecting Hydro were being given currency in the press and they were quite contrary to representations that Mr. Gaby would be making to the municipal representatives. The Commission then regarded, and still regards, Mr. Gaby's course as entirely appropriate and his comments as fully justified.



*Night scene—Chats Falls Development.*

# Future Applications of Electrical Energy

By W. P. Dobson, Chief Testing Engineer, H.E.P.C. of Ont.

*(Presented to Association of Municipal Electrical Utilities at Toronto, February 1, 1934).*

THE discovery of electromagnetic induction in 1831 by Faraday marked the beginning of a new epoch in the history of science. It inaugurated the power age. Since Faraday's time scientists and engineers have developed the principle which he discovered and have applied these developments to the needs of mankind; this process is proceeding at a more rapid pace to-day than ever before. In this vast field several landmarks stand out as marking vantage points gained which have been made the starting point for accelerated progress and a brief review of these is necessary as an introduction to the discussion of the future of electricity.

The mathematical physicist Maxwell in endeavouring to transform the theories of Faraday into mathematical language concluded from his investigations that light and electricity were closely connected and propounded the electromagnetic theory of light. This wonderful conception reached by the processes of mathematical thought is second in importance not even to Faraday's original discovery. Maxwell deduced that electrical energy and light travel with the same speed and are essentially the same in character. His work inspired scientists to endeavour to prove or disprove the existence of electromagnetic waves, and after twenty years the German scientist Hertz succeeded in producing and detecting these waves and in subjecting them to reflection just as light waves are reflected. Thus an immense new field was disclosed the cultivation of which has enriched civilization with many fruits of research, among them radio communication.

The invention of the incandescent lamp by Edison, Swan and others was a notable step and Edison's development of the direct current distribution system, centered on the incandescent lamp, was the first successful attempt to supply electricity for public consumption.

The invention of the alternating-current transformer was another epoch-making step. It made possible the distribution of electricity over greater areas than was possible by direct current.

It is curious that the first applications of electricity were for the purpose of obtaining light since Faraday's discovery would naturally suggest the application to mechanical uses. This is more remarkable because of the fact that at the time of Faraday's discovery sources of mechanical power were being eagerly sought.

In 1888, Tesla invented the polyphase alternating-current motor and thus made possible the transformation of electrical energy into mechanical

work on a commercial scale. This invention marked the beginning of the invasion by electricity of the mechanical field, which has to-day resulted in the displacement of practically all other agents in industrial factory operations.

The development of generators, of turbines, of long distance transmission, and of the applications of electricity as we know them to-day, followed naturally as the fundamental work of these pioneers became better understood and as inventive ability prompted by the needs of industry was applied to the solution of these problems.

The electrical industry dating from the invention of the incandescent lamp is barely fifty years old and in that short space of time it has gained a dominant position in practically every field of application. Beginning as a source of light it has been extended to embrace other fields such as electrochemistry, transportation and all the mechanical arts. That it is one of the most vigourous industries is indicated by the fact that during the present industrial depression it has suffered less than almost any other industry. The present then is a fitting time to survey and analyze the state of the industry and to endeavour to determine in what directions it is likely to proceed in the future.

Before beginning any such discussion it is necessary to define its limits. It would be quite easy to speculate on the applications of electricity say 100 years hence. Such speculations while interesting and attractive would offer no useful result. It is more useful to confine ourselves to picturing the near future as indicated by present trends. It is also necessary because of space limitations to confine the discussion to those applications which demand appreciable quantities of energy and among these some will be stressed more than others as being in need of particular emphasis. There will also be implied throughout the discussion a local viewpoint dictated by conditions such as, e.g. the nature of the sources of energy in Ontario.

The applications of electricity may be classified as follows:

1. As a source of light.
2. As a source of heat.
3. As a source of mechanical work.
4. As an auxiliary agent.
   (*a*) To aid some natural process, such as chemical action, plant or animal growth.
   (*b*) To control some process.
5. As a means of communication.

### Electricity as a Source of Light

The first application of electrical energy continues to be one of the most important and one which is receiving attention in the most intensive manner at the present time. Present endeavours are directed towards producing more efficient sources of light and towards the extension of its applications both in scope and degree.

When we survey progress in the improvement of efficiencies we must admit that it has not been satisfactory. While it is true that notable advances have been made, the fact remains that the present sources of electric light fall far short of perfection. Most of the energy supplied to the incandescent lamp is given off

in the form of heat and only the most efficient lamps produce much more than 10 per cent. of the power consumed, in the form of light. What are the possibilities of improvement? The limitations of the incandescent lamp are dictated by the melting point of tungsten or of other solids which may be used to give off light by incandescence. The theoretical limit of efficiency of an incandescent solid is 91 lumens-per-watt and this would still have low optical efficiency; that is, most of the radiation would still be heat. However, if we could produce material which would give off only lights rays, that is, rays between the wave lengths of 8,000 and 4,000 units we should have "cold light". The efficiency of such a source would be 370 lumens-per-watt. This would be a tremendous advance. However, there are further theoretical possibilities. White light is a mixture of different colours, each colour corresponding to a certain wave length or group of wave lengths. It is possible, however, to produce a light having a single wave length. Sodium vapour can be made to produce such a light, and the efficiency of such a source would be the highest we can imagine in the light of our present knowledge, 624 lumens-per-watt.

We conclude from this that the incandescent lamp will disappear. Even its maximum possible efficiency is too low. Even when we have produced cold light we shall probably not be satisfied and shall seek to obtain the efficiencies represented by the sodium light. If we could attain this perfection what would it mean? Let us apply it first to the lighting of our houses.

Let us assume that the average house consumes about 1,800 watts for lighting. The most efficient incandescent light theoretically possible would produce the same illumination with 350 watts. Cold light would require only 70 watts, and the monochromatic yellow light 35 watts.

Similarly a factory 100 feet by 200 feet lighted to an intensity of 50-ft. candles would require power as follows:

| | |
|---|---|
| Present tungsten lamps— (20 l.p.w.) | 512 kw. |
| Most efficient incandescent lamp (91 l.p.w.)......... | 112 kw. |
| Cold light (320 l.p.w.)..... | 28 kw. |
| Monochromatic yellow light (624 l.p.w.)........ | 16 kw. |

You will see from a perusal of these figures that on this assumption we should have available illuminations which while not approaching daylight yet would be so much greater than present illumination that it would almost turn night into day.

We may thus see radical changes in methods of illuminating houses. Present types of lighting fixtures will disappear and we shall be able to control intensities, colours and points of application so as to produce at will any desired decorative effect or lighting value. We may conceivably use fluorescent and phosphorescent materials in the walls and ceilings which may be combined with the light sources to produce these effects.

Similar changes may be expected in lighting factories, public buildings, highways and in all other applications of light. It may be calculated that by the use of sodium light the modern highway may be illuminated to an in-

tensity of 3-ft. candles with an expenditure of 2 kw. per mile. This would be sufficient illumination to permit of driving without head lamps and is equivalent to the illumination on a cloudy day in January about 5 p.m. in Toronto. The possiblity of illuminating our highways with 2 kw. per mile would place it within the power of people to light practically every mile of the main highways of the country.

While this discussion is speculative, it is in my opinion by no means impossible that some of the results described will not be achieved. They may come sooner than we imagine, perhaps as a result of research in pure science now in progress.

As a matter of fact the necessity of revolutionary progress in the near future is indicated by an estimate of present light needs.[1] It has been estimated that the required economic level of illumination in the United States is equivalent to 161 billion kw-hr. per year, or over 1,300 kw-hr. per person per year. This is about seven times the present energy consumption of the electrochemical industry.

Energy demands of this magnitude will certainly direct attention to improvements in the efficiency of its application.

We have been considering the applications of light as an aid to vision. It has also been applied to aid natural processes, such as plant and animal growth. Radiation from electric lights had been shown to promote plant growth and there is some evidence that it will promote animal growth. Much research will be necessary before these processes are fully understood and the value of present applications at least the economic value, has not as yet been fully demonstrated. If and when they are demonstrated these applications will furnish an important market for electrical energy.

The application of radiation to medical therapy is not new. Certain radiations such as X-rays have important applications but the value of some of the radiations recently exploited by the electrical industry has not yet been proven to the satisfaction of the medical profession. If this application be proved beneficial it will also absorb an important amount of electrical energy, but in the meantime the industry should not promote it without due regard to medical research otherwise the application will be unsound and will eventually harm the industry as well as the public.

### ELECTROCHEMICAL APPLICATIONS[2]

The progress of electrochemistry has been one of the most amazing phenomena in the history of electrical engineering The electrochemical industry in a space of a little more than thirty years has spread over all the world, and the annual value of its products is close to $1,000,000,000. Within the past ten years the output of electrochemical products has been trebled. It is estimated that the annual energy consumed by only eight products was in 1929 21 billion kw-hr. as compared with 10 billion kw-hr. in 1919. The cradle of this industry is Niagara Falls, but there are important

[1] Electrical Engineering, October, 1933, p. 716.

[2] Electricity in Chemical Processes. Fink. Electrical Engineering. March, 1933, p. 151

developments in Canada, in Spain, Norway and Sweden, and vast developments completed or in course of construction in Russia and Africa.

The refining of copper is chiefly carried on by electrochemical means. Over thirty per cent. of the world's caustic is made electrically. Electrolytic chlorine has made possible a new solvent industry and a new process for the recovery of metals from their ores; electrolytic rubber is now being produced. The calcium carbide industry is one of the largest consumers of electrical energy as is also the ferro-alloy and electric-steel industry. The latter has had phenomenal growth. The number of electric steel furnaces has increased from a score in 1909 to over 1,200 at the present time. The abrasive industry is dependent on the electric furnace and consumes much power. Lithium is now produced by electrochemical means, also metallic sodium. The electrolytic copper industry is one of the oldest of the group. There has within the past six years been a phenomenal increase in the number of electrolytic copper plants in all parts of the world including two in Canada. Electrolytic zinc made its appearance first during the world war. In 1929 the electrolytic zinc industry required twice the electrical energy consumed for the world's output of copper. A recent addition to the list is electrolytic iron.

Perhaps the most interesting development has been electrolytic aluminium. In 1929, 300,000 tons were produced and 7 billion kw-hr. of energy consumed. Without doubt this industry will undergo vast extension in the future for several reasons. In the first place the supply of raw materials is practically inexhaustible. For every pound of copper in the earth it is estimated that there are 4,000 pounds of aluminium. There is practically twice as much aluminium as iron. In the next place this metal according to present trends is destined to enter the widest variety of new fields and it is predicted by some that the next age will be called the "aluminium age".

The rapid progress which this industry has made within recent years and is still making and the activity of research laboratories in adding to the list of electrochemical products clearly indicate that it will be an increasing consumer of electrical energy. Indications of radical changes as a result of this are already evident, for example, the extension of aeronautics, the necessity for lighter and higher speed railway trains, of faster and lighter ships, of lighter and stronger buildings, etc. It has been estimated by authorities that in ten years the power consumption of the electrochemical industry will be at least 30 billion kw-hr.

A most interesting new use for electricity was tried out two or three years ago by the Detroit Edison Co.

Briefly, the process consists in making coal gas and coke in the following manner:

In a vertical steel cylinder lined with fire-brick a core of coke, contained in thin metal pipe is set; bituminous coal is packed around this core; alternating current is then turned on and heats the core; the core heats the coal surrounding it changing it into coke which then, becoming a conductor, heats up and carries its own current thus carbonizing more

coal and so on in ever-widening circles till the whole mass is carbonized.

The process takes about 350 kw-hr. per ton of coal charged and it is said to be very flexible in respect of the use of off-peak energy, it being possible to shut off the current for several hours without detriment. The power factor is from 90 to 95 per cent.

It is claimed that both the gas and coke produced are satisfactory for ordinary use. The Detroit Edison Company experimented with the process in a 1½ ton retort and then built and operated a 30 ton one. They say that the reason they have not adopted the process themselves (the company operates a manufactured-gas plant and supplies gas to the public) is because of the threatened competition of natural gas which was being brought into the Detroit region at the time when they abandoned their experiments.

The process appears to be attractive on account of its simplicity and ability to utilize off-peak and surplus energy.

Electrochemical applications include several most important products—electrolytic gases such as oxygen and hydrogen. By the simple process of passing a (direct) current of electricity through water two of the most important gases in the world are produced—hydrogen. which is a fuel gas—and oxygen, a supporter of combustion.

Each of these gases is already of very considerable importance in industry and both are capable of being put to many new uses on a stupendous scale. A few years ago the annual production of oxygen throughout the world was about 5½ billion cubic feet, and of hydrogen about 100 billion feet. This quantity of hydrogen would require about 2 million horsepower if all of it were obtained electrolytically, and 50 billion cubic feet of oxygen would be available as a by-product. Some of the present and future industrial and other uses of these gases are noted below.

The main outlet for oxygen is for welding and cutting; on a much smaller scale it is used in lead-burning (battery work), metal spraying and in hospitals for anaesthesia, resuscitation and therapeutic purposes.

Possible future uses would create some very large markets; some of these uses are:

In blast furnaces; in steel making; in the manufacture of ferro-alloys.

In the production of oil-gas for use as city gas.

In the production of water-gas from coal (or coke) and steam. This can be enriched with oil-gas to form a suitable city gas.

In industrial furnaces for the attainment of very high temperatures.

In the manufacture of nitric acid from ammonia. It is already being so used in some of the world's synthetic ammonia plants.

The largest use of hydrogen at present is in the manufacture of synthetic ammonia one of the so-called "nitrogen-fixation" processes, the next largest use is in the hydrogenation of oils to fats (e.g., the changing of vegetable oils to such products as "crisco" which is used in cooking.

It is used in the oxy-hydrogen flame in welding and cutting and in aeronautics. It is also used in some of the

synthetic ammonia plants as a means of obtaining the necessary nitrogen from the air.

Hydrogen is being used on a large scale in Germany in the hydrogenation of coal to produce gasoline and the process has been developed in a large trial plant in England. A few months ago the daily papers reported that the British government is going to give financial assistance in establishing a large commercial plant for the hydrogenation of coal.

In Germany and England, where coal is relatively cheap and water power is not so abundant as in Canada the hydrogen is obtained from water gas obtained by blowing steam over hot coal or coke. In Canada if electrolytic hydrogen production were developed on a large scale it is possible that with low rates for power electrolytic hydrogen could some day be utilized e.g., in hydrogenating the lignites of Northern Ontario.

The Standard Oil Company has a plant in the United States in which crude is hydrogenated and it is said that 100 per cent. of it can be converted into gasoline.

Perhaps the latest use for hydrogen is for the cooling of electric generators. A future possible use for hydrogen and one which under suitable circumstances could be developed to very large dimensions is the reduction of ores.

The production of mechanical power by hydrogen used in internal combustion engines is being developed in Germany and it is claimed that satisfactory results have been obtained.

As the long distance transmission of energy in the form of gas at high pressure is said to be (for a given amount of energy) much cheaper than with electrical energy (1/3 the cost is the figure named by those who have looked into this subject)—and as gas can be transported hundreds of miles without undue difficulty, there is some likelihood that before many years are over energy in the form of hydrogen may be transmitted for heating, chemical and possibly for other purposes. In this connection it should be mentioned that electrolytic cells are now being experimented with in Germany in which oxygen and hydrogen are generated at high pressure (3,000 lbs. per sq. in. or higher) in the cell itself, thus obviating the need for compressors. Considerable economies are claimed for this method.

The electrolytic production of oxygen and hydrogen is attractive to electrical supply authorities because it is very flexible and can readily be adapted to off-peak operation—moreover if surplus power be available it is possible to install cells utilizing surplus power and operate them at reduced load, and when surplus power is no longer available and off-peak must be resorted to, the same cells can be operated at a higher load (for fewer hours per day), thus giving the same output as before. In the latter case the efficiency would come down somewhat but this can be kept within reasonable limits by installing suitable capacity in the first instance.

In the electrolytic process both hydrogen and oxygen are always produced simultaneously and while, in certain industries, either gas may have a value high enough to warrant its use alone, there are others in which the economic price of one gas is low and

the problem in such cases is to find a reasonable market for the other.

It is largely this feature which has prevented the more wide-spread use of this process throughout the world up to now.

### Mechanical Power Applications

The invention of the polyphase alternating current induction motor was the step which signalled the application of electricity to the mechanical operations of industry. The possibilities of this device appear to be unlimited and it has been developed within the past 40 years so that it completely dominates practically all fields of mechanical applications. It is the most versatile member of the electrical family, with the exception perhaps of the electronic tube and it is to-day applied to operations extremely diversified in type. Within recent years, it has been adapted to speed control within wide ranges, its former objectionable feature of large starting current has disappeared; "across-the-line" motors have eliminated expensive starting equipment so that it is now practically a universal motor. Within the past 25 years advances in design have made possible a six-fold increase in rating with no increase in dimensions. The applications to factory drive, transportation (rail, vertical, marine) are well-known. These are expanding rapidly. The application of motors to the propulsion of ships, and to fuel-electric trains, give evidences as to their important and dominating characteristics since these applications all involve the addition of an item of equipment between the prime mover and the work. There appears no likelihood that any other source of mechanical power will appear which can compete with the motor and it may with reasonable confidence be predicted it will maintain its supremacy in the application of mechanical force to industrial operations. There are possibilities, too, of immense expansion. While the electric automobile may not be realizable there are indications of progress in this direction—a gasoline electric delivery truck has been developed commercially. In the agricultural domain vast opportunities for application await the appearance of a satisfactory electric tractor.

### Thermal Applications

The applications discussed here include electric heat applied to assist in mechanical processes, to heat materials for direct consumption, and to promote bodily comfort. Its application to the production of new materials are discussed under electrochemical applications.

In the majority of cases heat units generated by electricity cost more than the same number of useful heat units from fuel, hence electricity must show compensating benefits. That it can do so in many cases is proven by the startling rapidity with which electricity has displaced fuel in industrial heating processes. Present trends indicate that electrical energy will be used in rapidly increasing quantities in industrial heating. Its advantages are of an enduring character, and there appears to be no controversy as to its merits in this field.

We enter a highly controversial field however when we discuss the application of electricity to the heating of buildings. Its advantages in

the electrical field have led many to ask why it cannot be applied immediately to the heating of houses and other buildings. To these it should be pointed out first that the application of electricity to the heating of buildings, that is, for the purpose solely of maintaining the comfort of the occupants of those buildings is essentially very inefficient. In industry heat is applied usually in very restricted spaces to inanimate objects which can be so insulated that great losses are avoided. However, in the heating of buildings most present methods involve the heating of a volume far in excess of that occupied by the persons in the building.

A complete discussion of the applications of electricity to house heating is beyond the scope of this paper. It is only possible to state the generally accepted results of investigations in this field as applied to this locality.

The various methods proposed may be grouped in two classes: In the first electricity is the sole means of producing heat; in the second it is used as an auxiliary of fuel.

It does not appear practicable in this climate to heat houses solely by electricity principally for the reason which has been mentioned in the discussion of industrial heating; namely, that heat units produced by electricity cost more than heat units produced by fuel and the compensating benefits are not sufficient as in the case of industrial heating to make it an economically sound application, principally because of the inherent inefficiency in its application as discussed above.

Changes in methods of heating buildings may make necessary a slight modification of the above statement but will not affect the general result. These methods involve a more efficient application of heat so as to make it unnecessary to maintain a large volume of air at relatively high temperature.

A name "panel" heating has been applied to a method of heating by low temperature radiation. Under this method the walls and ceiling of rooms, or portions of them, are maintained at temperatures slightly below body temperature, and in this way the radiation of heat from the body is reduced and bodily comfort maintained even if the air temperature may be as low as 50 deg. fahr. This method has been applied in several important installations in the United States and England and great economies are claimed for it, also greater comfort than with the older methods. There is a possibility that this method may lend itself to the application of electricity, but this has not yet been established.

Another method of heating buildings was suggested over 80 years ago by Lord Kelvin, but only recently has any attention been paid to it as a commercial possibility. This is the so-called "reversed refrigeration". Under this method a refrigerator is used to extract heat from the outside air and pump it into the house. It is theoretically possible to do this no matter what the outside temperature may be, but the size of the refrigerating plant, that is, the maximum power required will depend greatly upon the outside temperature and consequently it appears almost obvious that it would not be possible to apply it economically to maintain a large

volume of air even in a house of ordinary size at a comfortable temperature, in our climate. It has however been applied to the heating of a large office building in California, where it has added advantage that it may be used to cool the building in the summer time.

The attractive feature of this method, as pointed out by Lord Kelvin, is that by the expenditure of a given amount of energy in the refrigerating plant several times that energy may be obtained as heat. There are possibilities that this method may have important applications in this climate as an auxiliary heating agency for use in the fall and spring months and thereby effect economies in the use of coal.

Summarizing this discussion we may say that electricity, while it may find local conditions favourable to its application as the sole source of heating buildings can, in general, only be used in our climate as an auxiliary to other methods. Present trends, however, indicate that it may have important applications as an auxiliary even in this climate, but these applications are not yet proven and much research is necessary before they can be.

An application of electric heating which is indicated by present trends is the heating of soil in order to improve plant growth. It has been proven that the heating of soil under certain conditions may be an economically sound application and offers a large market for electrical energy. These applications from present indications will be to small areas in green houses or in fields. The application on a large scale has not yet been proven.

The preceding discussion may be summarized as follows:

1. The most rapidly expanding field of application (having due regard to the present depression) and that likely to consume the greatest amount of energy in the near future is the electrochemical industry.

2. The domestic and agricultural applications are practically unlimited.

The domestic load offers an exceptionally attractive field not only because of its potential energy-demand but also because of its stability. It appears to be less affected by industrial fluctuations than any other type of load.

3. The greatest possibilities for improvement in efficiency of equipment appear to be offered by the electric light.

4. In some applications electricity has definitely displaced other agencies, in others it can only be applied as an auxiliary to such agencies, in others it is in direct competition with them.

Based on the above discussion and analysis we may attempt to answer the following questions. On what do future applications of electrical energy depend?

In the first place they depend in a very important measure on the cost of electricity. We must then enquire whether the cost is likely to increase or to decrease. Much has been written on this subject and some authorities have concluded that overall costs of electric plant and operation are not likely to decrease if present engineering practice is continued. Capital costs are not decreasing and in the

opinion of some authorities they cannot be greatly decreased below present figures in the case of steam plants or of Hydro-electric plants on rivers of variable flow. Hydro-electric stations located on rivers of constant flow offer possibilities since it is not necessary to provide peak-load plants as in the other two cases. This is an encouraging fact as applying to the future of the power situation in Ontario, since the greatest future source of power—the St. Lawrence river—has a fairly constant flow. Factors tending to increase costs are the increase in underground systems and the necessity for longer transmission lines as more remote courses of power are developed.

Engineering practice as far as it relates to equipment for the generation, transmission and distribution of power is tending towards larger and larger units. It becomes of increasing importance in order to reduce maintenance and operating costs that the materials entering into this equipment be of high quality so that breakdowns will be infrequent and that designs be improved so as to increase efficiencies, reduce weights and dimensions. This involves research not only on the properties of materials but on the design of equipment.

It is universally agreed that costs may be reduced by improving the use of electricity, that is, by improving load factors.

The necessity of increasing load factors points to certain loads as being desirable to encourage, for example, intermittent electrochemical processes, such as the electrolytic production of oxygen and hydrogen. The seasonal fluctuations of load involve problems of great difficulty and some means must be found either of storing off-peak energy available in the summer season or of discovering new loads which will fit into the present seasonal load curve. Such loads are not in sight.

It should not be lost sight of in any discussion of load factor that discrimination is necessary in choosing markets for off-peak power since it is conceivable that the application of low rates for off-peak loads would eventually, perhaps rapidly, result in completely changing the load curve so that the off-peak requirements would surpass those of former peak periods and thus the valley of the load curve would become the peak. The former rates applying to peak load would then have no significance and rates would have to be set for such industries which would then be consuming off-peak power; thus a vicious circle would result.

Nevertheless the conclusion cannot be avoided that at the present time it is necessary and practicable to make a considerable improvement in load factors both seasonal and daily.

As stated above electricity has been forced into competitition with fuel in many industrial applications. In many of these there need be no conflict if both the electrical and the gas industry take a broad-minded view and do not urge applications which are not in the interests of national economy. However, there are now, and may be in the future, many applications for which gas and electricity appear to be equally suited. In such cases it is to the interest of the electrical industry to use every fair means in its power to sell its product. It is

worth while for us to note that the gas industry fully realizes this situation and that it is taking energetic steps to turn back the attack of electricity on its strongholds and by research to improve and extend the applications of gas.

The American Gas Association which operates throughout both the United States and Canada maintains extensive research laboratories in which co-operative investigation is carried on in all fields of the gas industry.

Another important potential source of competitition is oil. Its applications are rapidly extending and it is likely to compete both with electricity and gas in domestic and agricultural applications.

It is evident from the discussion of the various applications of electricity that each of them depends upon the solution of certain problems. This leads to the consideration of the factor upon which all future applications depend and which is implied in each of the factors already mentioned.

Research, in the broadest sense of the wood will determine the future applications of electricity research directed towards the solution of the technical and the social problems of the industry; the intelligent application of scientific discoveries and of economic laws; the elimination of cut-and-try methods; the minimizing of waste effort caused by conflicting interests.

On the technical side research will be directed towards cheaper and better service.

It has been stated above that great reductions in investment costs are not probable under present practice. However, the results of research may modify this statement. New discoveries may produce fundamental changes in practice or may make radical improvements in present types of equipment. For example, the development of a new or improved magnetic material may permit the multiplication of the output of generators and transformers without increase in weight or volume. Circuit breakers and lightning arresters of present designs, very expensive items in a power plant, may be supplanted by better designs, or entirely eliminated. Underground cables may be designed so that towers may be eliminated from transmission lines. No one can say that these results and others may not be attained in the comparatively near future as a result of research now in progress. It appears to me that they are indicated by present trends.

The costs of distribution are an important part of investment costs of power systems. These will be affected by the changes just mentioned, but new methods of distribution must be devised which will further reduce capital costs.

The cost of service, especially domestic service, can also be reduced by lowering the cost of utilization equipment both industrial and domestic. More efficient appliances must be developed—higher speed and more durable range elements, motor operated appliances having a greater variety of uses. Economies may be effected by the grouping of appliances. There are possibilities here to reduce both the cost of the appliances by combining common features of separate appliances and the cost of the wiring necessary to supply them. The

house of the future must be designed to provide for these advantages.

Cheaper service implies in part better service. But there is another essential, viz., uninterrupted and uniform supply of power. This involves problems not essentially different from those just discussed.

Much research is necessary to accomplish these results. The very practical problems connected with utilization as well as the more scientific problems of design, depend for their solution upon the expansion of our knowledge of materials—especially the thermal and electrical properties of insulating materials, and of magnetic and conducting materials. This in turn involves fundamental research on the properties of matter. In this field amazing transformations have occurred within recent years and much progress has been made towards a better conception of the structure of matter. The electrical industry has taken advantage of some of these developments and new applications will follow further advances in pure science. It may be that present research in pure science may produce a great change in engineering practice e.g., in power transmission. When we think of the changes produced in a few years in the field of communication by the application of these theories, we cannot close our eyes to the possibility of similar revolutionary changes in the power field. Research on the economic side is as necessary as technical research, and should embrace such subjects as load building and rates.

The social problems of the industry are equally important-problems involving conflicting interests or requiring co-operative effort for their complete solution. The problem of standardization is one, and closely connected with it, the problem of regulation. In these fields conflicts often arise unnecessarily. For example, the discussion of adequate wiring has involved the manufacturers, the power supply companies, the rule-making bodies and the Electric Service Leagues, and has centred on the Codes which regulate wiring installations. These Codes are concerned only with the public safety and safety to property and they endeavour to define what adequate wiring is from this point of view. Adequate wiring from the point of view of the suppliers of electrical utilization equipment and electrical energy is that which will offer the least sales resistance to their product. The determination of adequacy based on either point of view is difficult. Perfect safety is unattainable and "reasonable" safety is a vague expression impossible of definition, so that Codes are the result of compromise between conflicting opinions supposedly based on experience. It is equally difficult to define adequate wiring from the other point of view. The manufacturer and dealer sell equipment to the power companies for power production and to the power consumer appliances for utilization (of which wiring materials form an important part). If the cost of equipment is excessive, the cost of power will be high and the use of power and appliances by the consumer will be limited. If wiring installations are unequal to the energy demands of appliances which the consumer may desire, the dealer will find it more difficult to sell him the appli-

ances, since he is involved in the expense of enlarging the capacity of his installation. Wiring is one link in the chain. What is its relative importance? Can cheaper wiring methods be evolved which will be reasonably safe? Can the characteristics of appliances be improved so that present wiring will be adequate for connection to greater numbers of appliances? These are questions which should be answered. In order to obtain an answer they should be systematically and co-operatively studied. There is no better time than the present to begin this study.

### Summary and Conclusions

Electrochemical, industrial heating and domestic appliances offer the largest markets for electrical energy in the near future.

Electricity cannot be generally used for the heating of buildings in this district except as an auxiliary of fuel. It may have important applications in this connection.

The efficiency of its applications to illumination must be greatly increased.

Research is necessary—

(a) to reduce costs and improve service by improving designs of equipment and methods of distribution.

(b) to determine the technical and economic limitations of the use of off-peak power.

(c) to encourage use of power by improving utilization equipment.

The co-operative study of the social problems of the industry is urgently necessary.

Grateful acknowledgment is made to Mr. A. S. L. Barnes and Mr. Geo G. Cousins for their assistance. Mr. Barnes prepared the discussions on carbonization of coal and on electrolytic oxygen and hydrogen. Mr. Cousins made the calculations given in the discussion on the applications of light.

# Experiences on Water-Heater Campaign

*(Discussion at Association of Municipal Electrical Utilities Convention at Toronto, February 1, 1934).*

*Mr. J. W. Peart, St. Thomas:*

Between May 1, 1933 and January 27, 1934, 545 flat-rate and 13 booster water-heaters were installed in St. Thomas. These represented a connected load of 400 h.p.

Practically all of these heaters were of the strap-on type since the water supply has a hardness of 180 parts per million, which is sufficient to cause "liming up" of immersion and circulation type heaters at a rapid rate.

The St. Thomas Commission regard the Campaign as highly satisfactory so far, and look for much additional business with the advent of spring.

Any measure of success encountered in St. Thomas may be attributed to the following factors:

1. There were only 52 flat-rate water-heaters on the system prior to the present campaign.

2. The gas utility in the City is marketing a supply of 550 B.t.u. artificial gas at a rate of $1.25 per thousand feet.

### Method Adopted

The work of installing the heater equipment was divided equally among a dozen electrical contractors who were paid the rate set by the H.E.P.C. These contractors were authorized to canvass for contracts. Two independent solicitors were also engaged on a commission basis.

The 500-watt heater was set as the minimum size unit—370 of the 545 flat-rate units installed are 500 watt.

### Equipment

Generally speaking the equipment supplied by the H.E.P.C. was quite satisfactory. A few heaters were found to have a capacity considerably below the rating indicated on the name-plate. In three cases 500-watt units actually tested out to 460 watts. This has resulted in a regular routine of testing heaters prior to installation.

Thermostats have proven to be the source of a great amount of trouble. Of the four different styles received from time to time, all have given trouble in some degree. Until recently we were operating 100 heaters with the thermostat cut out. In the past two weeks new thermostats have replaced the defective ones, so that at present, all installations have the proper protection.

### Factors Which Defeat Successful Operation

The following difficulties were encountered in the past nine months which were directly responsible for unsatisfactory results:

1. Leaky hot water taps. Rubber washers do not last long on taps where the water temperature approaches 190 to 200 deg. The least drip will cause sufficient circulation to reduce the temperature materially.

2. Long runs of unprotected hot

water piping. This should be eliminated by placing the tank as near to the kitchen as possible and all hot water pipes should be covered with air-cell covering.

3. Defective cold water pipes which enter the tank at the top and extend towards the bottom, afford a most elusive source of trouble. We have encountered four cases where, after lengthy testing and switching of heaters, the tank was taken down and this pipe examined. In all four cases this pipe was renewed and good hot water obtained for the user as the result. In two instances, the notch in the pipe just inside of the tank was approximately ¼ in. by ¾ in. cut in a "V" by a hack-saw, which permitted the mixing of the incoming cold water with the hot water and resulting reduced temperature. Other cases have been found where the cold water pipe only extended two feet into the tank so that cold water was discharged a distance above the level of the heating element.

4. The fourth difficulty we find is lack of intelligent use by the consumer. Dishes are rinsed under hot-water taps with resultant waste and abnormal use. Bath-tubs are filled to the over-flow and taps are not turned off tightly. This is the type of user who tells you that they hardly use any water. We have used water meters to advantage in making tests which enlighten the user considerably as to his actual use. Such tests generally indicate the need of much larger capacity and when this is suggested with the accompanying increase in rate, the user starts to co-operate and make the small installation suffice.

Suggestions

1. Some consideration might be given the matter of re-designing the tank cover to permit the replacement of heaters or thermostats without the removal of the complete cover and wool.

2. Complete satisfaction can only be obtained from an installation which is adequate in winter as well as in summer. Cold water temperature in St. Thomas in the summer months averages between 58 and 62 deg., while in winter this falls as low as 36 deg. Heaters which give utmost satisfaction in summer fail deplorably in winter in many cases. This would indicate the need of booster heaters to insure best results.

3. It is difficult to arrive at the proper capacity of flat-rate heater in some cases. In one instance a 750-watt unit on a 52-gallon tank proved inadequate. The final solution was obtained by reducing the 750-watt unit to 600 watt with a corresponding drop in rate from $2.74 to $2.20, and the addition of a booster. The current to the booster was then metered for 30 days with the result that the total of the flat-rate and metered current fell slightly below the $2.74 amount and complete satisfaction was obtained.

4. Where a small tank is replaced by one of larger capacity, the old tank can be used to advantage on the cold water supply as a pre-heater. A lot of confusion would be avoided if our Canadian-made tanks were rated in Imperial instead of U.S. gallons.

5. We have made numerous tests through the use of water-meters on the cold water supply to the tank.

The installation and subsequent removal of a water meter was costing us $1.50 per test. We have overcome this by the purchase of several lengths of rubber hose and couplings. The water meter is now connected between any adjacent cold-water faucet and the drain tap in the bottom of the tank. Thus the cold water supply enters from the bottom instead of the top. This serves two purposes. In the first place it measures the quantity of hot water used, secondly it eliminates the use of the cold-water pipe entering the top of the tank during the test period. If this pipe is the source of trouble better results are obtained during the test.

6. Some standardization of plumbing methods would prove of material advantage in successfully continuing the campaign. The word of the journeyman plumber is held in reverence by the consumer, whereas any recommendations from the utility sponsoring the installation of heaters is very often regarded with a certain amount of suspicion.

7. There appears to be some settling of the rock wool after installation. We have found four cases where the top of the tank was bare, although we know definitely that it was properly covered at the time of installation. One case of trouble was corrected by the addition of wool.

8. Testing has revealed an average consumption per capita per day of 11.6 gallons.

*Mr. A. N. Robinson, Stratford:*

We choose to discuss for a moment the Hydro flat-rate water-heater campaign as experienced in our City.

Assuming that the preliminary advertising was done and active campaigning was under way, our first thought was the size of heater required for the given instance. It was a fact that we soon discovered that the average consumer knew absolutely nothing about the quantity of hot water used in his or her home. Therefore, to get some basis of comparison we installed water meters on the cold water supply pipe to the hot water tank and took daily readings. These readings revealed some very valuable information. We found by devoting some time to real investigation of requirements, much grief later was avoided.

Our records show after taking readings twice a day for a week on several installations that the average amount of hot water used per person, per day, is 8.4 gallons. The smallest amount used on a test installation was 5.4 gallons and the largest amount 11.3 gallons.

The closer the tank is to the kitchen sink the less water will be used, as there will be a smaller amount of hot water left to cool in the supply piping each time the tap is opened. The kitchen sink is where the big demand is for small quantities of hot water.

We had an installation in a home—30-gallon tank—500-watt heater, with 34 ft. run of bare ¾ in. hot water supply pipe to the kitchen. This was tried out for 5 days and we were never able to get water above 130 deg. at the kitchen tap. The installation being quite unsatisfactory, the tank was moved to within 10 ft. of sink and the same tank and heater has supplied sufficient hot water for the household needs for six months.

An institution with 10 ladies using water—8 teachers and 2 housekeepers. This household is well organized in the use of hot water. On a 17-day test they used an average of 8.55 gallons per day, per person, at an average temperature of 148 deg. Their means of heating water previously was furnace coil and a 3 kw. side arm heater.

Our Commission operates both the Gas and Electric Departments, and when we undertook this flat-rate water-heater campaign we had to be fair to both departments.

Therefore we took contracts for flat-rate water-heater service and left the gas water-heaters on as boosters with those consumers who already heated water with gas.

We have an interesting installation. The consumer had recently purchased an automatic storage gas water-heater, replacing the 30-gallon range boiler. This was in service for about 9 months and this consumer applied for a Hydro flat-rate water-heater. We re-installed the range boiler in series with the automatic gas water-heater and equipped it with the flat-rate water-heater covering, piping the cold water into this tank using it as a pre-heater for the gas water-heater. The outlet of 30-gallon boiler was connected to the inlet of the gas storage heater—then the hot water supply for the house was connected to the outlet of the storage tank, thus using the automatic gas storage heater as a booster. It is thermostatically controlled and gives exceptionally rapid recovery of hot water when needed. This has been found a very satisfactory installation for both departments, gas and electric, and the customer is satisfied with the service cost. On our survey of this installation we found that they were using 11.3 gallons per day, per person, at an average temperature of 135 deg.

Quite a number of our flat-rate consumers had either an electric or gas side arm water-heater which they wished to retain as boosters. Insulating the electric heater and the pipes connecting was not so serious, but with the gas heater we had to have a check valve inserted into the circulating pipes to stop circulation from the tank through the heater. On a gas heater with fume pipe and a long heating coil this waste radiation represented quite a considerable loss.

After much experimenting and thanks to the co-operation of the Hydro-Electric Power Commission Engineering Department, we got a check valve that works quite satisfactorily for this purpose. This valve we install at the bottom of the heater on the horizontal piping connecting the heater to the tank.

We have several interesting installations, but time does not allow us to touch on them—but we have one where the side arm heater was responsible for 40 per cent. of the consumer's bill. Another where the flat-rate water-heater reduced the consumer's bill 45 per cent. each two months, including the flat-rate charges. Undoubtedly, this consumer had his circulation heater on the peak load, and although his flat-rate heater is on the peak it is not so severe, and both the Commission and consumer are happier.

The campaign, we would say, is

by no means over — the flat-rate water-heater load represents 200 h.p.; 2.5 per cent. of our total average substation demand for the year, with a load factor of approximate unity.

*Mr. F. W. Peasnell, Toronto:*

In a time limited discussion on water-heaters it is only possible to touch very briefly on the results and experiences met with in actual practice.

The campaign started in Toronto and District last April, and by the end of the year 3,564 flat-rate water-heaters were installed, representing 3,165 in the city and 399 outside the city, with a total aggregate load in excess of 2,000 kw.

The average load for residences figured out at 636 watts, and for commercial 590 watts, the 500 watt and 600 watt being the popular sizes, with approximately 1,000–500-watt and 950–600-watt heaters installed.

Approximately 22.3 per cent., or 795 jobs, include a booster, with a total added load of approximately 1,600 kw. in addition to the flat-rate boosters.

The immersion type is used for all installations in Toronto and also outside whenever practicable, so that we only have about 10 strap-on heaters in use.

During the early part, what might be called the usual difficulties with newly designed equipment for a campaign of this magnitude, were met with, but I am glad to say these appear to have been overcome, thanks to the excellent co-operation and prompt attention rendered by the officials of the Ontario Hydro to meet requirements determined by actual practice as and when brought to notice. I am spreaking more particularly of the thermostats and the latest type, which is readily adjustable for high, medium and low temperatures on both the flat-rate and booster, is a decided improvement towards satisfactory service.

In Toronto a new tank, welded, not rivetted, is supplied to the customer as part of the campaign plan. This tank, with a minimum capacity of 40 gallons, is assembled complete in the Toronto Hydro workshop and installed on the consumer's premises in series with the existing tank owned by the consumer.

That is to say, the water supply enters the consumer's tank as previously and then passes to the new Hydro tank, and for a standard job it is only necessary to cut into the hot-water pipe without disturbing the tank belonging to the consumer.

This has many advantages, inasmuch as the assembly is standardized, more efficient and the new 40-gallon tank will undoubtedly give a longer life, with an appreciable reduction in maintenance, against the use of the existing 30-gallon tank owned by the consumer, as it is sometimes difficult from observation to determine the condition of a tank after it has been in service for several years.

The Hydro tanks are constructed so that the cold water pipe does not pass through the hot water inside the tank.

Regarding the suitable size of heater, this varies with each residence, as so many factors have to be taken into consideration, quite apart from the number of adults and children,

with or without maid, and size of house, that each case has to be dealt with individually.

A test was recently made as a result of complaint, when it was found that 96 gallons of water were used daily by a family of four, equipped with a 52-gallon tank and a 1 kw. flat-rate heater. On the other hand there are hundreds of houses equipped with a 600-watt heater, which gives satisfactory results for a family of four.

Following are a few examples of satisfactory service, as reported by the consumers:—

*Residences (where there is a maid it is usually necessary to provide extra capacity).*

(1) 2 adults, 1 child and maid—600 watt flat-rate and 3 kw. booster seldom used. Extremely satisfied and recommend this method to all friends.

(2) 2 adults, 1 child and maid—750 watt flat-rate. Hot water service satisfactory and a reduction in cost over previous method.

(3) 3 adults, 1 maid—600 watts satisfactory with booster, which is used only on wash days.

(4) 2 adults, 1 child and maid—600 watt flat-rate. Not satisfactory as three baths are taken daily, but consumer will not change to a larger heater.

(5) Family of 12—82-gallon tank, 2 kw. flat-rate in lower portion of tank, 500 watt flat-rate in upper portion of tank. Reports satisfactory service.

*Commercial Stores*

Total installed approximately 180, consisting of barber shops, beauty parlors, confectionery and candy shops and grocery chain stores.

Barber shops, using 40-gallon tank in each instance, report satisfactory service with capacity as follows:

500 watt flat-rate, 2 chairs, 1 basin.
600 watt flat-rate, 4 chairs, 1 basin.
700 watt flat-rate, 4 chairs, 2 basins.

The customer usually under-estimates the amount of hot water used. For example, a store estimated 50 gallons and it was found that 130 gallons were used daily.

It is natural that the average person expects the flat-rate water-heater is going to result in a large saving in costs, but this is not always the case where the previous heating method was turned "on" and "off" sparingly, whereas with a constant supply much more hot water is used, but a distinct saving in cost is experienced in the larger homes where a comparatively large quantity of hot water has previously been used.

However, it is a distinct advantage to the consumer to know the definite cost per month beforehand for a constant storage of hot water ready each morning without turning on switches, etc.

It has been our experience that complaints of insufficient hot water could have been avoided if the salesman had been given correct information by the customer.

Complaints have also been found due to extravagance in use of water; heavy demand for short periods; allowing hot water to run constantly when washing dishes; faulty washers on taps which involve a serious waste, much more than realized.

Mention should also be made that with the colder water supply in Winter there is an additional margin,

as much as 30 deg., to be taken care of as against Summer conditions.

### Circulating Type or Side Arm Heaters

Regarding the use of the customers' booster of the circulating or side arm type, with the flat-rate immersion type, it was found that when drawing hot water, a certain amount of cold water was siphoned through the side arm heater from the bottom of the tank.

This was overcome by inserting a special injector known as a "Doohickey nipple," consisting of a copper tube inside the supply pipe at the bottom of the tank and extending about two inches inside the tank.

The cold water supply passes through the inner copper tube to the inside of the tank and circulates back through the pipe outside the copper tube.

It is also recommended that side arm heaters should be covered to prevent radiation loss.

For installations outside the city the customer's tank is used the same as in other municipalities.

Side arm heaters are accepted when connected with a non-by-pass tee into the top of the tank, or as an alternative the side arm heater piping to enter the tank by the upper opening about twelve inches from top of tank.

This requires a restriction valve, preferably below the heater in the cold water line to restrict the flow of water when the heater is not in use.

### Load Builder for New Business

It should also be mentioned that following upon a satisfactory water heater installation, consumers who have not an electric range have become interested, and an added amount of range and refrigerator business with Red Seal wiring has actually been obtained.

Therefore, in addition to being a satisfactory load, the water-heater giving satisfaction in large numbers is talked about and becomes a load builder for other household appliances.

### Complaints re Bills

The number of complaints regarding bills rendered has been comparatively few in number. Some of these were due to blown fuses and excessive use of booster; others on account of premises not occupied, etc.

### Rentals for Booster Heaters

Consumers seem to object to the rental charge for booster heaters and consider that, if necessary, the same should be included as part of the campaign.

This seems worthy of consideration, due to possible emergencies when an extra supply of hot water is required quickly, and the failure by not having a booster to obtain same reflects on the efficiency of the flat-rate storage method.

### Experiences Using the Existing Tank Owned by the Consumer, Outside City

Not located in proper position.

Rusted water pipes, which when disturbed, split and have to be replaced.

Tubes on cold water inlet broken off inside tank.

Holes in wrong place.

Long runs of water pipe to risers.

Difficult in certain instances to determine from observation the condition of the tank, which may develop leaks after the heater has been installed.

When found that the hole for flat-rate is too high, a new hole is cut and fitting brazed rather than welded.

Thermostats—Location on Tanks

It has been suggested that the thermostat should be placed at the same level, further to one side of the heater, which is under consideration.

The high temperature for the flat-rate thermostat is set at 170 deg., and the booster at 145 deg., with about 10 deg. regulation for each notch.

The residents in Toronto, however, have in the past been accustomed to the use of very hot water, so that in certain instances it is necessary to set these thermostats higher.

The bi-metallic thermostat is now used on all heaters.

For installations above 82 gallons capacity two new Hydro tanks are installed in series, and examples of reported satisfactory service are as follows:

(1) One 100 gallon with 2 kw. flat-rate at bottom. One 52 gallon with 400 watt flat-rate at top and 600 watt flat-rate at bottom. All thermostats set at 170 deg.

(2) One 100 gallon with 2 kw. flat-rate at bottom. One 66 gallon with 1 kw. flat-rate at bottom and 3 kw. booster at top.

(3) One 66 gallon with 1,250 watt flat-rate at bottom. One 30 gallon with 300 watt flat-rate at bottom and 3 kw. booster at top.

The flat-rate heater is located about six inches from the bottom.

The booster heater is located about twelve inches from the top.

With a circulating water return pipe method we suggest an extra 200 watts to take care of loss by radiation.

Maximum Size of Water Heater in Relation to Size of Tank

The following sizes have been determined by results in actual practice:

| | Heater should not exceed |
|---|---|
| 30-gal. tank........ | 750 watts |
| 40-gal. tank........ | 800 " |
| 52-gal. tank........ | 1250 " |
| 66-gal. tank........ | 1500 " |
| 82-gal. tank........ | 2500 " |

For installations requiring a 3 kw. flat-rate it has also been found advisable to install two tanks in series with a total capacity of 150 gallons, using a 2 kw. heater in the first tank and a 1 kw. in the second tank, in which also is located the booster.

Quite a large number of these heavy duty installations have been completed and without exception are giving satisfaction.

The following is mentioned for consideration:

(1) To develop an inexpensive and easy method by which the consumer can determine the approximate quantity of hot water in the covered tank at any time.

(2) A method to indicate if flat-rate heater is out of service due to burn out, etc.

In summing up the situation, it is safe to say that the water-heater

campaign in Toronto is a decided success and additional tanks are being assembled in readiness for the further demand next Spring when other present heating methods now in use are discontinued.

*Mr. F. S. Rhoads, Windsor:* In Windsor and the Border Cities, we have experienced certain difficulties met by other municipalities in the Flat-Rate Water-Heater Campaign. In one respect, however, we are faced with a situation that is not very common and that is the great variation in the temperatures of summer and winter incoming water. At the present time, the water has a temperature of 33 to 35 deg. fahr., while in the summer the temperature runs from 70 to 74 degrees.

When we started to install heaters last Spring, we had very few complaints, for the reason that the thermostat, being placed below the heater, the heater ran practically all the time, and was able to provide sufficient hot water. When the summer came with the tap water at a much higher temperature, we received many complaints of too much hot water, and in most cases, overcame the difficulty by replacements with smaller heaters. This worked very well till the Fall and Winter came on, when we received complaints of the opposite nature, "Not enough hot water".

In our case, we find that flat-rate heaters, which provide the necessary hot water in the summer months, are not capable of hot water requirements in the winter months, and similarly, heaters large enough to take care of winter requirements, give too much hot water in the summer, when the water is at a much higher temperature.

The solution of the difficulty apparently is to provide a flat-rate heater of sufficient size for summer requirements, and have a booster to provide extra hot water for the winter months. We have experienced considerable difficulty in selling the booster idea to our consumers, and as a matter of fact, our flat-rate installations have boosters only to the extent of 4 per cent. With an additional charge of 25 cents per month for the booster, our customers feel that it is not necessary and that they can get along without it. We feel, therefore, that it would be much better to have the booster given away in the initial installation, and to have the capital charges for the booster and accompanying equipment as well as the necessary maintenance charges included in the monthly charges for the heater.

Using the customer's tank, as has been the usual procedure in most municipalities, we have run into certain difficulties resulting in a lack of sufficient hot water that has been charged unfairly to the electric water heater. In many cases, it is found advisable to move the tank to a more suitable location, and very frequently the customer objects to the extra plumbing costs or is not willing to have the tank taken away from the furnace, and thereby lose the help of the furnace coils. Making use of the old tank very often leads to difficulty, owing to a defective down pipe, and in addition, the usual tank found in the home is of 30 gallons capacity or less, and is not of sufficient storage capacity for the size of the flat-rate heater used.

For the reasons enumerated above, we have come to the conclusion that the practice followed by one of the larger municipalities in supplying new forty gallon tanks, leaving the old tank in position as a pre-heater has much to commend it, and will result in removing many of the troubles, we are now experiencing. Going a step further, and supplying a booster heater controlled from the basement, will give a more complete installation that will go far to popularize electric water heating, than has thus far been reached. We favour a larger booster than the conventional 1,500 watt size and feel that a booster large enough to give a quick supply of hot water is very necessary. We believe that a thermostat should be installed on the booster, but that it is not necessary for the flat-rate heater.

We have satisfied quite a few customers in the colder weather, who have complained of a lack of hot water, by replacing the furnace coils. In some cases, it has been necessary to replace the furnace coils in part only, so as to make up the difference in the temperature of the winter water, as compared with summer. We feel that many customers are going to be satisfied with the aforementioned arrangement, who would not be otherwise, and we see no reason why use should not be made of the furnace coils, particularly when the customer believes that this costs him nothing extra.

We have had some experience with apartment houses, and have found some cases, where the immersion heater installations have not been satisfactory, and have remedied the trouble by making the immersion heater into a circulation type, which has had the effect of giving quick recovery of hot water. Heaters of this type have proven very satisfactory on apartment house installations.

We find that each hot water job is pretty much a separate problem of its own, and we are looking forward to a continuation of the hot water campaign this year.

*Mr. V. A. McKillop, London:*

Flat-rate water heaters have been available in London for 8 years. There were 1,453 of these customer-owned heaters in operation when the free installation offer was made early this year; since that time 1,251 free heaters, including 29 boosters, have been added. These divide as to size as follows:

| | | |
|---|---|---|
| 417— | 400 watt . . . | 166,800 watts |
| 560— | 500 " . . . | 280,000 " |
| 136— | 600 " . . . | 81,600 " |
| 84— | 750 " . . . | 63,000 " |
| 18— | 1000 " . . . | 18,000 " |
| 36— | 1500 " . . . | 54,000 " |
| 1251 | | 663,400 " |

Average, 530 watts.

Assuming that each of our 7,000 electric stove owners is a potential customer for electric water heating, there is still a large market for this appliance. It is expected that next spring will witness another big demand for them.

Installations have been made in restaurants, banks, apartments, boarding houses, as well as homes. Several commercial jobs range in capacity from 2.5 to 9 kw., in tank capacity from 80 to 250 Imp. gal., and in daily consumption from 150 to 600 Imp. gal. All are giving first

class satisfaction. The large installation, namely 9 kw. 250 gal. storage and 600 gal. consumption had originally only 200 gal storage and a complaint was received that the supply was insufficient during the evening. A test revealed the fact that the thermostat was cutting out for about 2 hours in the early morning. The customer's old tank was then connected in parallel with the big new tank, the thermostat remained in the one position throughout the 24 hours and results were entirely satisfactory, without additional heating capacity.

Where more than one tank is used they are connected in parallel, and usually all heaters are on one tank. Cold water enters one tank from the top and is led to a point near the bottom. There are connecting pipes, both top and bottom. A few domestic installations have been made on old tanks where it was necessary to return later and extend the cold water pipe deeper in the tank to prevent mixing near the top.

About 15 per cent. of the installations have been made on new tanks and about the same number of old tanks have been moved to a more desirable location at a charge averaging under $3.00. One cover was removed after a joint on top had leaked and allowed water to run through the insulation. The new tank was found to be badly pitted and the galvanizing removed over a large part of the surface. If, as it appears, water can set up some action between the insulation and tank, this should be the subject of immediate investigation. When it becomes necessary to dismantle a tank cover to change the heater size, or for any other reason, the insulation is invariably found sticking to the cover. Another tank leaked when water grounded the cable between the thermostat and heater, thereby burning a hole in the tank.

Two complaints have been corrected by reversing the hot and cold connections on the tank; it was found that the installation had been improperly made because the hot pipe was drawing from the bottom of the tank, and the cold pipe feeding in at the top. It has also been found that Monday is a favourite day for complaints during the first two or three weeks after an installation has been made. After that people appear to develop a schedule within the limits of the service for which they are willing to pay. The inspection of an installation which is the subject of a complaint is best undertaken early in the morning. The customer will find it difficult to criticize unfairly if the tank is hot when the inspector calls.

It must not be inferred that much trouble has been encountered. The complaints amount to only a small percentage of the installations; some are justified and some are not. Among the former is the case where a private plumber and electrician co-operated on an apartment, housing, as we learned later, 52 people. They had installed 1600 watts on 100 gallons storage. However, estimates of requirements appear to have been largely correct, 17 have been changed to a larger size and 32 to a smaller size. Capacity has usually been determined by the number of persons in the house, although a graphic water meter has been of great assistance par-

ticularly in the commercial applications.

The selling campaign has been conducted by the regular Hydro Shop staff. It was found that a regular routine of evening calls proved most effective. These included prospects previously contacted in the store and others. Although in the beginning considerable doubt as to the savings that could be made through removal of the furnace coil was encountered, this attitude seems to be disappearing. The Hydro Shop has been busy since the campaign began. Water-heaters appear to have created interest in other appliances and caused an upward trend in sales generally.

*Mr. P. B. Yates, St. Catharines:*

When we started in the water-heater campaign, we did not anticipate any extraordinary results, first, because we had a goodly percentage of our domestic consumers using flat-rate water-heaters in this district of cheap 1,100 B.t.u. natural gas and second, because over the course of time, a number of those water-heaters which had been installed were becoming unsatisfactory in their operations. From the first installation of electric water-heaters on our system, we have, in the office, declared that no water-heater would be connected up unless the installation was made in a way that would give us reasonable hope of satisfaction to the consumer, but I believe that the outside staff were not as careful in refusing service to unsatisfactory installations as they should have been. In addition, water boilers will rust out and must be replaced and installations that were originally made in a fairly satisfactory manner were replaced by uncovered boilers. We also found that the local prejudice was increasing where there was a hot water coil in the furnace and the electric heater used only during the summer time. This lead to a great many installations where the coil in the furnace was a highly efficient cooling coil for the hot water heated by electricity during the summer.

We have initiated a movement to increase the number of electric stoves in use in the Province and I have been appointed a member of the Maintenance Committee to study the subject of maintenance and repair of electric stoves. I believe that this Committee will recommend that municipalities initiate a Department to inspect consumers' services and give to the consumers free of charge except for parts, the cost of repairing electrical equipment so that the load will remain on our lines. If this is done, the same attention can be given to the sale and maintenance of electric water heaters-and I believe that such a campaign will do more to retain the existing water-heaters in service to give satisfaction to the consumers and in this way, spead throughout our Systems a popular prejudice in favour of water heating by electricity.

# Association of Municipal Electrical Utilities

## Auditors' Report

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR YEAR ENDING DECEMBER 31ST, 1933.

### RECEIPTS

| | | |
|---|---|---|
| Cash in Bank, Dec. 31, 1932 | | $ 938.67 |
| Membership Fees: | | |
| Municipal.... | $1,440.00 | |
| Commercial.. | 340.00 | |
| | | 1,780.00 |
| Convention Receipts: | | |
| January, 1933. | $2,003.80 | |
| June, 1933.... | 1,255.25 | |
| | | 3,259.05 |
| O.M.E.A. Contribution... | | 153.17 |
| Interest on Bonds: | | |
| 1000 Prov. 5% | $50.00 | |
| 500 Dom. 4½% | 22.50 | |
| Talons 1% | 5.00 | |
| | $77.50 | |
| Int. on Deposits | 25.14 | |
| | | 102.64 |
| | | $6,233.53 |

### DISBURSEMENTS

| | |
|---|---|
| Convention Expenses: | |
| Dinners and Luncheons. | $3,266.75 |
| Entertainment......... | 460.91 |
| Reporting............ | 122.75 |
| Printing.............. | 463.99 |
| Badges............... | 168.18 |
| Sundry Expenses...... | 132.75 |
| | $4,615.33 |
| Travelling Expenses...... | 364.60 |
| Remuneration, Secretary.. | 150.00 |
| " Treasurer.. | 125.00 |
| Printing............... | 97.02 |
| Bank Exchange on Cheques | 24.70 |
| Postage................ | 62.45 |
| | $5,439.10 |
| Balance in Bank, December 31st, 1933........... | 794.43 |
| | $6,233.53 |

### ASSETS

| | | |
|---|---|---|
| Cash in Bank........... | | $ 794.43 |
| Dominion, 1959, 4½% Bond | | 500.00 |
| Province of Ont., 1948 5% Bond................ | | 1,000.00 |
| Projecting Machine | $243.45 | |
| Less for Depreciation........... | 218.45 | |
| | | 25.00 |
| | | $2,319.43 |

We certify that the above statements disclose the true condition of affairs of the Association as shown by the books and Vouchers covering the year ending December 31st, 1933.

(Sgd.) H. P. L. HILLMAN,
W. G. PIERDON,
*Auditors.*

## Report of the Committee on Accounting and Office Administration for the year 1933

On January 25th during the Winter Convention a meeting of the Committee was held which brought forth discussion on a number of matters.

The committee expressed itself favourably as to the holding sectional meetings at which modern methods of office administration and equipment would be discussed and shown. Accordingly, it was decided to have a typical office layout set up for the June convention at Windsor, this to be followed by other meetings during the fall.

Considerable discussion took place as to the ways and means adopted by different municipalities in connection with outstanding accounts of indigent consumers. The idea was to arrive at some standard method of following through this item.

At the Windsor convention, in accordance with the arrangements previously made, a typical office layout was set up. This equipment consisted of Billing, Adding, and Addressing Machines, Filing equipment, Visible Records, Forms, Furniture, etc. Difficulty was found in carrying out this idea, due to the limited space and to the large number in attendance.

As noted in an issue of the Bulletin, Mr. W. G. Pierdon, Chief Accountant of the Hydro-Electric Power Commission, gave a very interesting outline of the Commission's finances which effected the local Utilities. Mr. Pierdon's remarks were well received and gave many of those present an insight into the Commission's affairs which they did not before realize.

Some discussion took place on matters pertaining to Accounting, and Mr. Hanna, of the Legal Department, gave those present some legal opinions on the working of the various Acts governing the operations of local commissions.

At a meeting of the Georgian Bay Municipal Electrical Association, held in Owen Sound on September 13th, the Accounting Department of the Hydro-Electric Power Commission, at the request of this Committee, set up a typical office layout which drew forth discussion, and the approval of those present.

A sectional meeting at Kingston in November was proposed, but, due to unforseen difficulties, this had to be abandoned.

It is proposed to carry on this work at the Winter convention, and a committee is at work in order to be ready for this phase, and we look for a good attendance and results from this meeting.

The sub-committee, appointed at the Bigwin Inn Convention, for the purpose of revising the standard system of accounting for Municipal Electrical Utilities, beg to report progress, and are in hopes of having a report ready for the approval of the 1934 Winter convention.

The thanks of the committee are tendered to the members of the Committee representing the Provincial Commission's Staff, for their untiring

efforts, and to the representatives of the various manufacturers and firms who supplied machines and equipment for the exhibits, and to the members of the Committee who gave of their time and thought.

Respectfully submitted,

(*Sgd.*) M. W. ROGERS,
Chairman Committee on
Accounting and Office
Administration.

## Minutes of Convention

The thirty-fourth convention of the Association of Municipal Electrical Utilities was opened at the King Edward Hotel, Toronto, on January 31st, 1934, at 11.45 a.m. The order of business of this session was the reception of reports and transaction of general business.

The auditors' report which had been published and circulated was presented showing total receipts and disbursements for the year 1933 to have been $6,233.53, with cash in the bank at the end of 1932 of $938.67, and at the end of 1933, $794.43. Assets totalled $2,319.43. It was moved by Mr. R. S. Reynolds and Seconded by Mr. H. F. Shearer "THAT the auditors' report be taken as read and adopted."—*Carried.*

Applications of James B. Erskine, Manufacturers' Agent, for Commercial membership, and Messrs. F. J. Hodges and T. D. Berry for Associates, were presented. It was moved by Mr. M. W. Rogers and seconded by Mr. C. A. Walters "THAT James B. Erskine be elected Commercial member and F. J. Hodges and T. D. Berry, Associates."—*Carried.*

A letter from Mr. R. W. Bierwagen, President, Ontario Electrical Contractors' Association, was read. This advised of the unsuccessful endeavours of that Association to obtain legislation regarding the licensing of wiring contractors, and asked for the privilege of attending the convention and addressing the delegates on this subject with the object of obtaining the Association's support. The Secretary advised that Mr. Bierwagen would be given an opportunity of speaking at the session of the afternoon of the next day.

A letter from the Secretary of the Lion's Club of Toronto was read, which invited any "Lions" of this Association to a meeting of the Club on the evening of February 1st.

Mr. O. H. Scott, Chairman Merchandising Committee, presented a report of that Committee which would be read at the O.M.E.A. meeting, and moved its adoption. On being seconded by Mr. R. S. Reynolds the report was adopted.

Mr. M. W. Rogers presented a report from the Committee on Accounting and Office Administration of which he is Chairman, and moved its adoption. On being seconded by Mr. J. W. Peart, Mr. Rogers' motion was *Carried.*

The session then adjourned.

At 12.30 p.m. the delegates met with the Electric Club of Toronto and the Ontario Municipal Electric Association for the first convention luncheon at the Royal York Hotel. The Honourable J. R. Cooke, Chairman Hydro-Electric Power Commission of Ontario, as guest speaker, gave "A Review of Some 1933 Features of the Hydro Undertaking".

The second session of the Convention opened at the King Edward Hotel at 3.00 p.m. The President declared the ballot for the election of officers for 1934 closed and asked the scrutineers, Messrs. T. R. C. Flint and T. C. James to retire and count the ballots.

The Secretary announced having received additional applications for Commercial memberships from International Business Machines and The Glidden Company, both of Toronto, and advised that if there was no objection these would be considered elected by the resolution passed at the morning session. There being no objection, the applicants were declared elected.

Mr. George G. Cousins, Engineer-in-Charge, Illumination Laboratory, Hydro-Electric Power Commission of Ontario, presented a paper "Better Light, Better Sight", which was illustrated by lantern slides and a visual demonstration. Discussion following Mr. Cousins' paper was by Messrs. J. W. Bateman, G. F. Mudgett, A. S. L. Barnes, and R. E. Love.

Mr. H. L. Summerlee, Burroughs Adding Machine of Canada, Limited, presented a paper, "Stub Plan of Consumer's Accounting". Discussion following Mr. Summerlee's paper was by Messrs. O. H. Scott, G. Appleton, George Grosz, R. M. Bond, P. B. Yates, C. A. Walters, J. R. McLinden, and C. E. Brown.

Mr. E. D. Johnston, Remington-Rand Limited, gave a demonstration on the use of cards for recording transformers.

The results of the elections of officers of the Association for the year 1934 were then announced as follows:

President—W. R. Catton, Brantford.

Vice-President — O. M. Perry, Windsor.

Secretary—S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

Treasurer—D. J. McAuley, H.E.P.C. of Ontario, Toronto.

Directors—(from the Membership at large): Messrs. E. V. Buchanan, London, D. B. McColl, Walkerville and O. H. Scott, Belleville.

District Directors:

Niagara District—P. B. Yates, St. Catharines.

Central District—C. A. Walters, Napanee.

Georgian Bay District—J. R. McLinden, Owen Sound.

Eastern District—M. W. Rogers, Carleton Place.

Northern District—C. J. Moors, Fort William.

The session then adjourned.

At 7.00 p.m. the delegates met with the Ontario Municipal Electric Association for the Convention dinner. Following the dinner, Gilbert and Sullivan's "Trial by Jury" was produced, after which the Reverend Banks Nelson of Hamilton gave an address.

The third session of the Convention opened at 10.00 a.m. on February 1st.

Mr. H. C. Powell, Statistician, Toronto Hydro-Electric System presented a paper "Domestic Load Possibilities". Discussion following Mr. Powell's paper was by Messrs. Joseph Showalter, H. F. Shearer, E. V. Buchanan, A. W. J. Stewart, V. B. Coleman, A. S. L. Barnes, O. H. Scott and C. E. Schwenger.

Mr. W. P. Dobson, Chief Testing Engineer, Hydro-Electric Power Commission of Ontario presented a paper

"Future Applications of Electrical Energy". Discussion following this paper was by Messrs. E. V. Buchanan, C. E. Schwenger, H. C. Powell, A. S. L. Barnes, and H. C. Barber.

The session then adjourned.

At 12.30 p.m. the Association met with the Ontario Municipal Electric Association for the second convention luncheon when Controller James Simpson, Toronto, addressed the delegates on the League of Nations.

The fourth session of the Convention opened at 3.00 p.m. when Mr. R. W. Bierwagen, President Ontario Electrical Contractors' Association, who had asked for the privilege of addressing the Association regarding proposed legislation to license all wiring contractors, spoke.

Following Mr. Bierwagen's address it was moved by Mr. W. R. Catton and Seconded by Mr. E. V. Buchanan "THAT this Association is in sympathy with the Ontario Electrical Contractors' Association in the matter of licensing wiring contractors and THAT the Executive of Ontario Municipal Electric Association be asked to consider it."—*Carried.*

Contributions to a discussion on "Experiences on the Water-Heater Campaign", were made by Messrs. J. W. Peart, St. Thomas; A. N. Robinson, Stratford; F. W. Peasnell, Toronto; F. S. Rhoads, Windsor; V. A. McKillop, London and P. B. Yates, St. Catharines.

Mr. O. W. Titus, Consulting Engineer, Canada Wire and Cable Company, Limited, and the Standard Underground Cable Company, Limited, Toronto, presented a paper entitled "Copper", which was illustrated by lantern slides and moving pictures.

The Chairman in a short address expressed his gratitude to the various Committees and contributors to the programme who had made the Convention a success.

The Convention then adjourned.

The Convention register shows a total of 503 to have attended the Convention, being classified as follows:—

| | |
|---|---|
| Class "A" | 107 |
| " "B" | 234 |
| Commercial | 71 |
| Associates | 44 |
| Visitors | 47 |

There were 554 present at the Convention luncheon with the Electric Club of Toronto on January 31st. At the Convention dinner on the same evening, 475 attended, and at the Convention luncheon on February 1st, there were 467 present.

## Minutes of Executive Committee Meeting

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the King Edward Hotel, Toronto, at 10.00 o'clock, on the evening of Wednesday, January 31st, 1934. Those present were Messrs. W. R. Catton, Chairman; O. M. Perry, D. J. McAuley, C. A. Walters, C. J. Moors, E. V. Buchanan, D. B. McColl, M. W. Rogers, J. R. McLinden, T. W. Brackinreid, O. H. Scott, P. B. Yates and S. R. A. Clement.

It was moved by Mr. T. W. Brackinreid and Seconded by Mr. M. W. Rogers "THAT the Secretary and the Treasurer be paid, as an honorarium, amounts the same as last year."
—*Carried.*

The Secretary presented correspondence and advised that Hamilton, Bigwin Inn and Ottawa were bidding for next summer's Convention, and that representatives were waiting to lay their proposals before this Committee.

Mr. W. A. Stead, Manager, Royal Connaught Hotel, Hamilton, and Mr. McLean, of the Hamilton Chamber of Commerce, were received and they outlined proposals offered by Hamilton pursuant to correspondence received from the Royal Connaught Hotel, the Hamilton Chamber of Commerce, Mayor H. E. Wilton, and N. S. Braden, Vice-President Canadian Westinghouse Company. They reported the dates of June 21st, 22nd, and 23rd, available and quoted hotel rates of $3.50 per day, single, and $6.00 double, European plan.

Mr. S. Forsyth, Assistant Manager, Bigwin Inn, outlined facilities as have previously been obtained there and quoted $6.00 per day, American plan, and suggested dates of June 28th, 29th and 30th. Mr. S. M. Green, General Agent, Canadian National Railways attended when reference was made to letters from the Canadian National Railways, Ottawa Board of Trade, and Ottawa Industrial and Publicity Commission, suggesting Ottawa for the Summer Convention. Dates of June 28th, 29th and 30th were suggested and a flat rate of $4.00 per day single, and $3.50 per person if two in a room, European plan, was quoted for the Chateau Laurier.

After discussing the various proposals it was moved by Mr. P. B. Yates and seconded by Mr. E. V. Buchanan "THAT the summer Convention be held at Bigwin Inn."

Amendment moved by Mr. O. M. Perry and seconded by Mr. T. W. Brackinreid, "THAT the summer Convention be held at Ottawa, the dates to be June 21st, 22nd, and 23rd, if these can be arranged, otherwise accepting the dates suggested for the Chateau Laurier of June 28th, 29th and 30th."—*Carried.*

Standing Committees for the year 1934 were drafted as follows:—

Papers Committee: Messrs. D. B McColl, Walkerville, *Chairman*; E. V. Buchanan, London; C. E. Schwenger, Toronto; A. S. Edgar, Canadian General Electric Company, Toronto; A. B. Cooper, Ferranti Electric, Toronto; T. A. Gass, Canada Wire and Cable Company, Toronto; and W. P. Dobson, Hydro-Electric Power Commission of Ontario, Toronto.

Convention Committee: Messrs. O. M. Perry, Windsor, *Chairman*; D. B. McColl, Walkerville; V. A. McKillop, London; O. H. Scott, Belleville; J. E. Brown, Ottawa; F. Mahoney, Canadian General Electric Company, Toronto; C. H. Hopper, Ferranti Electric, Toronto; R. H. Starr; G. F. Drewry, and J. W. Purcell, H.E.P.C. of Ontario, Toronto.

Regulations and Standards Committee: Messrs. C. A. Walters, Napanee, *Chairman*; C. E. Schwenger, Toronto; J. W. Peart, St. Thomas; W. J. Jackson, London; R. J. Smith, Perth; P. B. Yates, St. Catharines; F. W. Peasnell, Toronto; W. P. Dobson, H.E.P.C. of Ontario, Toronto, and A. G. Hall, Electrical Inspection Department, Toronto.

Committee on Accident Prevention and Health Promotion:

Messrs. J. R. McLinden, Owen Sound, *Chairman*; J. E. Skidmore, Cobourg; H. G. Hall, Ingersoll; R. S. Reynolds, Chatham; E. J. Stapleton, Collingwood; J. W. Peart, St. Thomas; C. A. Walters, Napanee; V. A. McKillop, London; F. D. Hubbell, Windsor; T. C. James, G. F. Drewry, E. R. Lawler and Wills Maclachlan, H.E.P.C. of Ontario, Toronto.

Merchandising Committee: Messrs. O. H. Scott, Belleville, *Chairman*; J. E. B. Phelps, Sarnia; F. S. Rhoads, Windsor; W. H. Childs, Hamilton; I. N. Pritchard, Chatham; H. F. Shearer, Welland; A. W. J. Stewart, Toronto, and G. J. Mickler, H.E.P.C. of Ontario, Toronto.

Rates Committee: P. B. Yates, St. Catharines, *Chairman*; W. H. Childs, Hamilton; V. S. McIntyre, Kitchener; J. E. Teckoe, Niagara Falls; C. E. Schwenger, Toronto; R. S. Reynolds, Chatham; J. W. Peart, St. Thomas; T. W. Brackinreid, Port Arthur; O. M. Perry, Windsor; D. B. McColl, Walkerville; E. V. Buchanan, London; O. H. Scott Belleville; C. A. Walters, Napanee; J. R. McLinden, Owen Sound; M. W. Rogers, Carleton Place; C. J. Moors, Fort William; D. J. McAuley and S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

Committee on Accounting and Office Administration: Messrs. M. W. Rogers, Carleton Place, *Chairman*; D. B. McColl, Walkerville; C. W. Berquist, Hamilton; A. B. Manson, Stratford; I. N. Pritchard, Chatham; W. E. Wallace, Windsor; R. S. King, Midland; H. Clegg, Peterborough; J. W. Bayliss, Niagara Falls; George Appleton, Toronto; A. D. Nelson, Kingston; G. F. Shreve, Oshawa; G. F. Drewry and R. M. Bond, H.E.P.C. of Ontario, Toronto.

Auditors: Messrs. H. P. L. Hillman, Toronto, and W. G. Pierdon, H.E.P.C. of Ontario, Toronto.

It was moved by Mr. O. H. Scott and Seconded by Mr. P. B. Yates "THAT the Committees as drafted be appointed."—*Carried.*

The meeting then adjourned.

*Cameron Falls Power House—Nipigon*

THE

BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

# The New Administration Building of the Hydro-Electric Power Commission of Ontario

THE Hydro-Electric Power Commission of Ontario announces the award of a general contract for the construction of its new Administration Building, to be located immediately adjoining its present building at 620 University Avenue, Toronto, to Anglin-Norcross Ontario Limited, amounting to about $1,500,000. This award is made following complete consideration of all tenders recently received from general and various sub-trade contractors.

Similar tenders for the construction of the Commission's building were requested in the fall of 1932. Unfortunately, at the time these previous tenders were under consideration, business conditions in general and particularly the situation with respect to international exchange, underwent a sudden and adverse change, with the result that the Commission deemed it a part of prudence to defer its plans for proceeding with this work at that time.

The Commission believes, however, that the present is a specially opportune time to proceed with this much needed addition to its administrative offices. At a time when the business world is slowly but it is hoped steadily recovering from the depths of the recent depression, construction work of this nature, giving as it does much needed employment to a variety of industries and to the various skilled mechanics of the building trades, should serve to stimulate general conditions, as well as to perhaps point the way to others contemplating work of a similar nature. The recent marked improvement in the investment market, evidenced by sharply reduced interest rates, affords assurance that stimulus to recovery applied at the present time will be really effective, and, moreover, low interest costs are in themselves an important reason for proceeding with construction at the present time.

It is eighteen years since the Commission moved to its present Administration Building at 620 University

## CONTENTS

Vol. XXI No. 4

APRIL, 1934



Avenue, Toronto. With the steady expansion of the Commission's activities in the intervening years bringing increase of investment from $14,000,000 to $288,000,000, increase of power supplied from 180,000 horspower to 1,500,000 horsepower, and increase in number of municipalities served from 191 to 757, the staff required to administer the various engineering, operating and accounting phases of the undertaking has grown far beyond the capacity of the building constructed in 1916.

To accommodate the staff required to handle the increased work the Commission has resorted to converting adjacent dwelling houses and factory buildings into office quarters and, more recently, to renting space in other office buildings, with the result that the staff is now distributed in some 12 different buildings separated by a mile or more. It is difficult properly to co-ordinate the different phases of administration of the "Hydro" undertaking and to secure desirable efficiency with the various departments situated at such distances from each other.

The new Administration Building now to be constructed will have a frontage of 130 feet on University Avenue and 110 feet on Orde Street, rising eighteen stories high; a modern office building in every respect. Approximately 150,000 square feet of office space will be provided on the seventeen office floors, sufficient to accommodate, with the present building, all the present staff and still leave provision for future growth.

The architectural design of the building has been carried out by Messrs. Sproatt and Rolph, as architects engaged by the Commission. All other work of design has been carried out by the engineering staff of the Commission, assisted insofar as the structural design was concerned by Messrs. Harkness and Hertzberg and in the heating and ventilating design by Messrs. Thomas and Wardell.

# Better Light, Better Sight

By Geo. G. Cousins, Engineer in Charge, Illumination Laboratory, H.E.P.C. of Ont.

(*Presented to Association of Municipal Electrical Utilities at Toronto, January 31, 1934*).

NO better proof of the need for better light is required than the statistics showing the conditions of the eyesight of those engaged in gainful occupation and a step farther back reveals the more serious condition of the eyesight of school children, more serious because they are in the formative stages of life. Having acquired defects during childhood and youth they are compelled to face the stern realities of life handicapped by an additional burden that requires the expenditure of energy that would otherwise contribute to the well-being of the individual.

The prevalence of sub-normal vision is shown by eye examinations and tests that have been made in various places. Naturally the skill and carefulness of those conducting the tests have much to do with the accuracy and reliability of the results, and it is to be expected that variations in the results will occur. However, all the data reveal a very serious state of affairs. Tests of over 483,000 school children revealed eyed efects approximating 25 per cent. Another survey of 11,780 school children showed that 37 per cent. of them had defective vision. These tests were spread over wide areas. In industry examinations of large numbers of employees showed that about 66 per cent. had defective vision.[1] All of these defects cannot be charged againsc faulty lighting but it is a well-known fact that the lighting is a major contributing cause. It has been proved[2] that an improvement in lighting causes a greatet improvement in seeing for those with defective vision than for those with normal vision. There is thus the two-fold value, to the eyes, of adequate lighting, it counteracts the tendency toward subnormal vision and improves the subnormal vision when it exists. Slight defects of vision cause headaches more than greater defects as the muscles may, by extra exertion, overcome the defect but more extensive defects cannot be overcome, a condition that is recognized, and the extra exertion which causes headache is not made.

### How the Eyes React to Illumination

The effect of illumination on the productive use of the eyes depends upon the proportion of the total time that the eyes are engaged in attentive vision. In offices, printing shops and many machine operations this amounts to about 70 per cent. of the total time.[3]

When the eyes are focussed upon some detail it takes time for an impression to be formed upon the retina although the uninitiated may think that the response is instantaneous. An attempt to read small print in weak light is a simple demonstration

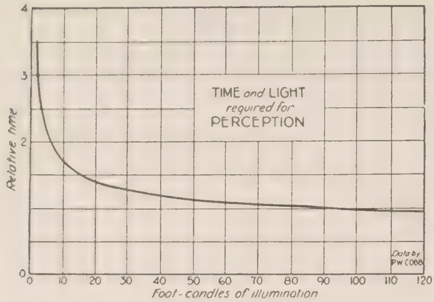



*Fig. 1—It takes 3½ times as long for the eye to perceive a small test object under 2 foot-candles as it does under 100 foot-candles.*

of this point. It may require one or more seconds to read a word. The same condition exists in varying degree depending upon the intensity of illumination, the higher the intensity the shorter the time required for perception. The point to be emphasized here is that there is a continual decrease in the time required for the perception of details as the intensity is increased. Up to about 20 ft. c. the decrease in time is rapid but beyond that intensity the decrease is more gradual, up to over 120

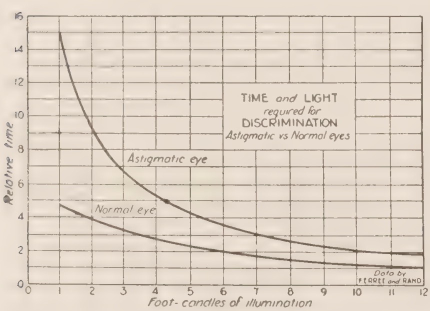



*Fig. 2—Normal eyes increase in speed of discrimination 3½ to 1 between 1 and 12 foot-candles; astigmatic eyes show even more pronounced improvement.*

ft. c. See Fig. 1. The ability of the eyes to perceive details in objects is improved by higher intensities as shown by Fig. 2. Note that those eyes with astigmatism are benefitted more than normal eyes. It must not be overlooked that all these improvements and others not mentioned are accompanied by less eye strain or fatigue.

With advancing age the ability of the eyes to focus on near objects becomes less[4], in other words, the near point recedes. This is shown by Table I, in which the near point figures represent the limit of accommodation for the near point.

It is possible to compensate to some extent for this loss of accommodation by increasing the intensity of illumination. Table 2 shows the foot-candles necessary to maintain equal visibility for different distances.

There is no shortage of data pointing to the need for better light so that better sight may follow.

### Glare

Glare is present to some extent in a great many lighting installations.

TABLE NO. I

The Near Point of Seeing Recedes With Age

| Age Years | Near Point Inches | Age Years | Near Point Inches |
|---|---|---|---|
| 10 | 2.7 | 40 | 9 |
| 15 | 3.1 | 45 | 12 |
| 20 | 3.9 | 50 | 16 |
| 25 | 4.7 | 55 | 20 |
| 30 | 5.5 | 60 | 40 |
| 35 | 7.1 | 65 | 80 |

Data by Luckiesh and Moss.

TABLE NO. II

| Ft. Candles | Distance for Equal Visibility Inches |
|---|---|
| 1 | 14.0 |
| 2 | 15.3 |
| 5 | 17.5 |
| 10 | 19.1 |
| 20 | 20.8 |
| 50 | 23.2 |
| 100 | 25.4 |

Data by Luckiesh and Moss.

By proper attention to the selection and placing of the luminaries it is possible to keep it within bounds so that its effect is not serious. The effect of glare is to decrease the ability to see objects or details. It operates very much like dragging brakes on a car, either reducing its speed or requiring more power to retain its speed. Glare produces an effect somewhat equivalent to reduced intensity of illumination and to offset this effect an increased intensity is required. Fig. 3 shows the relative glare produced by light sources at different angles from the line of vision.

Common causes of glare are the use of too small glassware and too low height. Glare is directly related to the brightness of the unit within the field of view. Consequently when a given amount of light is to be radiated from a lighting unit the larger its area is the lower will be the candle power of each square inch of visible area. This is illustrated by Table 3 while Table 4 shows desirable globe sizes for given sizes of lamps. Brightness is of particular importance where glossy covers such as glass and celluloid are used on desks. The eyes are more sensitive to light from below than from above and reflection on desk tops of bright objects are particularly harmful. This trouble is generally aggravated by the users of

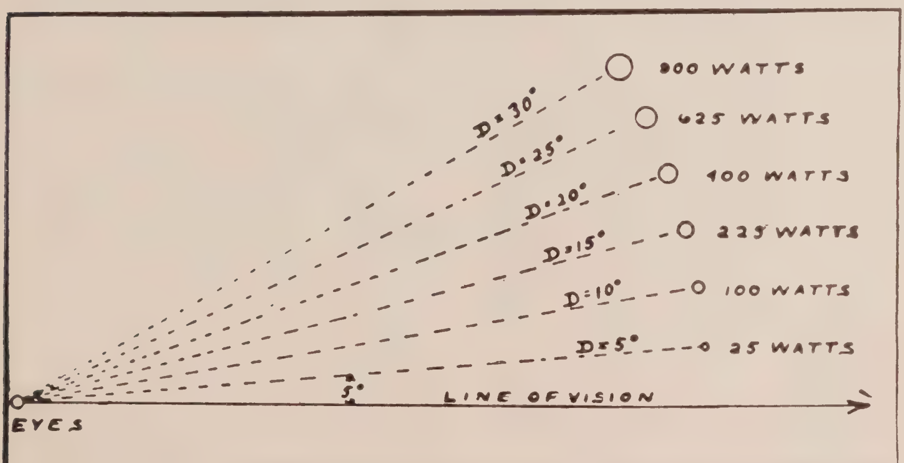



*Fig. 3—A low-power light source near the line of vision interferes with vision as much as a high-power source at a greater angle from the line of vision.*

TABLE III.

Brightness and Size of Enclosing Globes of Good Diffusing Glass*.

| Source | Diameter of globe (inches) | Brightness** (average candles per sq. in. of surface) |
|---|---|---|
| 100-watt lamp (gas-filled)..... | 5 | 4.5 |
| 100-watt lamp (gas-filled)..... | 6 | 3.1 |
| 100-watt lamp (gas-filled)..... | 7 | 2.3 |
| 100-watt lamp (gas-filled)..... | 8 | 1.8 |
| 100-watt lamp (gas-filled)..... | 9 | 1.4 |
| 100-watt lamp (gas-filled)..... | 10 | 1.1 |
| 100-watt lamp (gas-filled)..... | 12 | 0.8 |
| 100-watt lamp (gas-filled)..... | 14 | 0.6 |
| Sky........................ | .. | 2.0 |

* The globes are assumed to be fairly uniform in brightness and to have an overall efficiency of 85 per cent.

** A lambert is 2.054 candles per square inch.

such desks trying to overcome the evil effects of reflected glare by the use of lamps of greater power which in turn makes the condition still worse.

Lighting in Schools

"An ounce of prevention is better than a pound of cure" is one of those bits of condensed wisdom that we all believe in and very few follow. When statistics show such an appalling condition respecting the eyes of school children does it not follow that the logical point of attack is the schools

TABLE IV.

Recommended Globe Sizes of High Efficiency, Good Diffusing Glass When Used Unshielded*

| Lamp size (watts) | Globe diameter (inches) | Brightness** of brightest square inch (approximate candles per sq. in.) |
|---|---|---|
| 50– 75.................... | 8 | 2.5 |
| 75–100.................... | 10 | 2.5 |
| 100–150.................... | 12 | 3.0 |
| 150–200.................... | 14 | 3.5 |
| 200–300.................... | 16 | 4.0 |
| 300–500.................... | 18 | 5.0 |

* The globes are assumed to be substantialy uniform in brightness.

** Values that obtain with the larger size of lamps.

themselves instead of allowing the individuals to find out to their permanent loss that their eyesight is impaired? Nobody in authority seems to care much and no serious attempt is made to check this continuous flow of seconds out of our schools.

The ever-present bug-bear, lack of funds, meets the lighting men whenever school lighting comes up for consideration and on the face of this it calls for courage to recommend even the minimum values of intensity. When our plans based upon the lowest intensities that are considered justifiable are submitted, are those in authority who reduce these recommendations willing to accept the full responsibility for their actions? What hope is there for better sight when better light is denied? If sufficient funds are not available to do the whole job it is much better to do part of the job properly than to attempt to cover a whole school on a restricted scale.

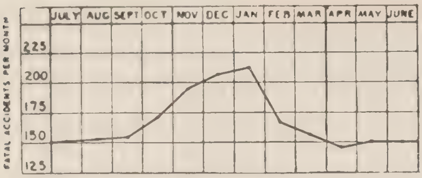
Some tangible results have recently been presented[5] to the Illuminating Engineering Society that show the economics of the problem. Two adjacent and similar rooms facing North were selected, one equipped with 2-150 watt lamp units manually controlled producing 2-6 ft. c. and the other equipped with 4-300 watt units producing 12-14 ft. c. and controlled automatically when the illumination on the darkest desk reached 12 ft. c. It is very significant that the lights in best lighted room automatically controlled were in use 35 per cent. of the school hours while the manually controlled lights were in use only 12 per cent. of the school hours. For three years the cost of the additional power for the better lighted room averaged $24.33 per year. The extra cost in operating expense to pass the additional failures from the poorly lighted room through the class, the second time was $168.00 per year. The pupils were carefully graded by tests and the teachers taught their respective subjects in both rooms. The results, therefore, represent the difference between good and bad lighting.

A very large percentage of our schools are poorly lighted and it may be that by adequate lighting many of the pupils that have to go through classes twice may pass the first time and the money thus saved would more than pay for the lighting. Aside from this purely monetary consideration each child is entitled to facilities that will, at least, not impair its natural endowments.

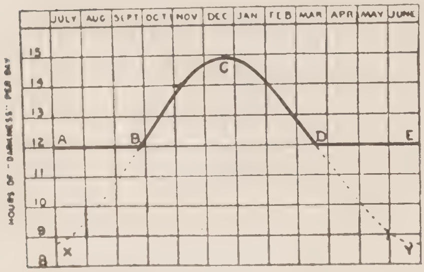
### Industrial Lighting

In no other field has illumination such a definite dollar and cents value as in the manufacturing of goods. Good illumination results in more efficient work, i.e., greater output on the part of employees, less spoilage of material, fewer accidents and better morale. It also benefits the workers by reduced eye strain, greater ease of seeing, less expenditure of nervous energy and more cheerful frame of mind. In spite of the economic value of good lighting one survey shows that light alone costs only about 0.3 per cent. of the value of the product.

Many times it has been found that good illumination has more than paid for itself, the net cost of production being reduced. This does not mean that the workers have to work harder,




*Showing relation of daylight to accidents.*




*Distribution of darkness by months.*
*Fig. 4*

but that their tasks are done with greater ease and faults are more quickly detected. The greater the proportion of the time that the eyes are actually at work on the job the greater is the possibility of an increase in output due to increased intensity of illumination. Tool-making, type-setting, inspection and garment-making are good examples of operations of this type.

Adequate lighting reduces the probability of accidents. Fig. 4 shows that more accidents happen during the periods of reduced daylight. It has been stated that the cost of accidents in a year is more than enough to pay the entire lighting bill for a year. If accidents happen they have to be paid for in any case. Since it is known that good lighting reduces the number of accidents a little additional money spent in improving the lighting will result in a two-fold saving.

Investigations to determine the limit of intensity beyond which no further increase in productiveness is obtained indicate that this point is reached at not lower than 25 ft. c. for operations requiring moderate accuracy. For the more precise operations the desired intensity may be two or more times this, which may be produced by localized lighting.

When relighting a factory (or any other place) it is generally not justifiable to do less than double the existing intensity. The actual intensity required depends among other conditions upon the size of detail to be discerned, its contrast with the back ground, its brightness, speed of motion and on the age of the workers.

### Commerce

In these days of keen competition in business merchants must take advantage of every means to attract prospective buyers to their stores. Good lighting has a double value, it not only attracts shoppers but renders easy the examination of goods.

The managers of chain stores realize fully the value of good lighting, even the most unobservant persons cannot overlook this fact.

In many of the moderate size stores and more of the small ones 200 watt lamps are used and it is a very common custom to have only alternate lamps burning during the day, even during the late fall when the days are dull and the public is in a buying frame of mind more than during any other season. The half-lighted appearance is conspicuous, the stores appear dull and uninviting. People do not shun these stores simply because half of the lights are out but

because the element of attraction is absent. They do not realize how great a power of attraction brilliant illumination has for them but all unconsciously respond to it.

If 10—200 watt lamps burning will make the difference between a dim store, and an attractive one the extra cost for 10 hours at 3 cents per kw-hr. is only 60 cents. Is there any other way that a merchant can increase the attractiveness of his store an equal mount for so little expense? Furthermore, money spent on beautiful and expensive furnishings and decorations, high quality merchandise and all the other inducements to tempt the public is wasted without adequate lighting. A simply furnished and decorated, well-lighted store, has more drawing power than an expensively furnished poorly lighted one, except specialty stores catering to a limited clientele.

The merchant's first appeal to the public is through his show windows. Here again lighting is the dominating factor. By actual test it has been found that increased intensity results in a greater percentage of the passers stopping to view the goods on display. By the judicious use of colour a further increase may be obtained without increasing the total wattage.

Beyond the intensity of illumination required to enable people to clearly see the goods on display, the amount of window illumination provided for advertising (attractive) purposes depends upon the state of window lighting in the neighbourhood. The merchant who wants to outdo his competitors must provide the better lighting, other things being equal.

### Wiring

No discussion of lighting is complete without a reference to the importance of wiring. It is the wiring that places the limitation on the lighting. In order for lamps to deliver their full amount of light they must be supplied with their rated voltage. The erroneous idea that Electrical Wiring Codes specify standard grades of wiring is a great obstacle to good lighting. A building wired according to the codes is simply wired so that the wiring will not get hot enough to set fire to the building. No. 14 wire will carry 15 amperes any distance, but beyond 25 feet the drop in voltage exceeds the two volts that is considered the limitation of good practise.

The loss in volts caused by 15 amperes flowing for 50 feet is 4 and by referring to figure 5 it will be seen that at 96 per cent. volts the loss in light is 13 per cent., and the reduction in watts only 6 per cent. There is thus a net loss of 7 per cent. in light. In other words, watts are paid for that do not produce light.

In good wiring installations No. 14 wire is only used for connections from the circuit wires to the socket terminals. In view of the slight added cost of adequate wiring while it is being done compared to practically prohibitive cost of increasing its capacity later it is good economy to provide carrying capacity for the next larger size lamps so as to provide for increased illumination as the general levels of illumination are raised.

### Conclusion

Mankind is becoming more and more dependent upon artificial il-

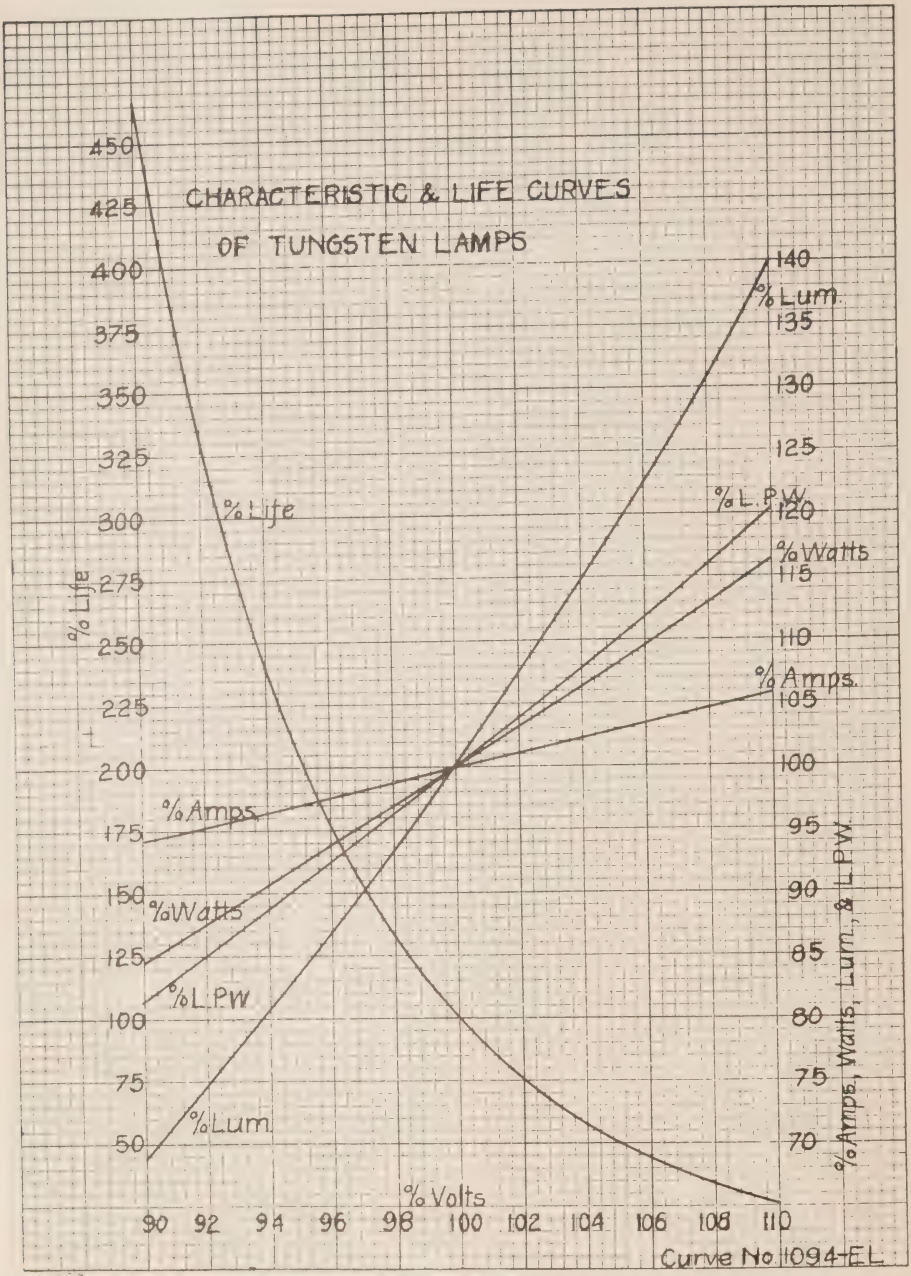

CHARACTERISTIC & LIFE CURVES
OF TUNGSTEN LAMPS
% Life
450
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
% Lum.
140
135
130
125
% L.P.W.
120
% Watts
115
110
% Amps.
105
100
95
90
85
80
75
70
% Amps, Watts, Lum, & L.P.W.
% Life
% Amps.
% Watts
% L.P.W.
% Lum.
% Volts
90 92 94 96 98 100 102 104 106 108 110
Curve No. 1094-E.L.

*Fig. 5*

lumination. In every field of endeavour it is playing a major part and on account of the ease with which it can be controlled and modified to suit particular needs it has become more reliable in many cases than daylight. While it is true that some of the more venturesome and progressive leaders in industry and commerce are using it on a more liberal scale than ever before, and profitably so, there is in general a woeful need of a greater appreciation of its merits.

Our lighting service throughout the Province brings us into contact with all phases of lighting and as a result we can observe conditions as they are. The lighting in a large percentage of schools, small stores and factories is about twenty years behind present standards.

There is an enormous amount of work to be done before the general level of illumination intensities approaches that which experience has shown to be economical and beneficial to all parties concerned.

The Illumination Laboratory of the Commission is ready to assist the local utilities with the lighting problems in their districts by making surveys of existing conditions and furnishing plans or recommendations for relighting old places or lighting new ones.

Better light is available. With the active interest and co-operation of the managers of municipal utilities in promoting the cause of good lighting in their respective districts we may hope for material advance toward better sight.

BIBLIOGRAPHY

[1] Eye-Sight Conservation Council of America.

[2] Studies by Ferree and Rand.

[3] Luckiesh, Journal Frank, Inst., 1928, p. 244.

[4] Luckiesh and Moss.

[5] F. C. Albert, Trans. I.E.S., Dec., 1933


*Display board erected at one of the main downtown corners in Windsor. Besides displaying their own merchandise, Windsor Hydro permits the private dealers to use the display rooms without charge.*

# Stub Plan of Consumers' Accounting

By H. L. Summerlee, Burroughs Adding Machine of Canada, Limited, Toronto

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 31, 1934).*

DURING the last few years the system of Consumers' Accounting generally referred to as the "Stub Accounting Plan," has been gaining in favour among utilities. The Bell Telephone interests in the United States and Canada have practically all of their subscribers' accounts numbering in excess of 10,000,000 on the stub plan. The first gas or electric utility to adopt the plan was probably a utility in Baltimore, Md. This accounts for the fact that the plan is sometimes referred to as the "Baltimore Plan." The plan is also referred to as "Bookkeeping Without Books," the "Modified Plan of Customers' Accounting," "Monthly Individual Ledger Plan," etc.

Rather than make a comparison of the stub plan with the ledger plan, it would probably be of more interest to analyse the stub plan with the view of determining what the stub plan lacks which the ledger plan provides. Advocates of the stub plan claim for it many desirable features which are not to be had under any other plan. There must be some good reason, therefore, why the stub plan is not universally adopted by utilities. Is this reason contained in the objections so often raised by public utility accountants who have not adopted the plan?

Let us see if we can raise all of these objections here and discard those which are of theory only, and not of practice, and place upon the others their true value.

In doing so, we will be drawing a comparison between the ledger and the stub plans without actually going into the complete detail of both plans with which you are all probably familiar. However, for the benefit of those of you who may not be familiar with the stub plan, we will briefly describe its method of operation.

Under the stub plan, an extra stub or coupon is made of each bill, and this stub takes the place of the ledger—that is, it is held in a "pending file" until the account is paid, when it is transferred to a closed file. The ledger stubs remaining in the "pending file" constitute at all times a detail of the amounts outstanding.

After the bills have been written and proven, the ledger coupons or stubs are detached and the bills proper, with the cashier's stub attached, are sent to the consumers. The ledger stubs are filed in the same order that continuous record ledgers would be filed if used—that is, in the geographical order in which the consumers appear in the meter reader's book.

As payments are made, the cashier's stubs are matched from day to day with the unpaid ledger stubs and the corresponding ledger stubs pulled from the active file and summarized, and the total thereof recon-

ciled with the total collected by the cashier. This verifies the fact that all stubs removed from the file represent actual collections and that stubs for all actual collections have been removed from the pending or unpaid file. Ledger stubs covering accounts which have been paid in full, are removed from the pending or active file, stamped or punched "Paid," or some utilities cut off a corner to indicate the payment, then filed in account order under a separate "Paid" file for that particular month. In the case of a partial payment the amount paid is usually posted to the ledger stub, which remains in the unpaid file until the balance is collected.

At the close of the month or period, the ledger stubs remaining in the pending or active file, represent the unpaid items, and their total should agree with the amount outstanding for the particular ledger unit. After these balances are transferred to the next month's bills and ledger stubs, they should be marked "Transferred" and then filed in account order in the "Paid" or "Closed" file for the particular month involved. This arrangement gives a separate document in the file for each month for each debit in the accounts. Most utilities take off a list of delinquents at the expiration of the discount date and reconcile the total thereof with the ledger control, after which the unpaid ledger stubs are placed in front of the paid stubs for the particular ledger unit and month, filing them all permanently in that order.

Now for the objections most frequently raised to the stub plan.

The stub or coupon may seem to be a flimsy record and a large number of such pieces of paper in an office as an accounting record, may not appeal to some accountants as being desirable. They are inclined to think of hundreds of loose stubs lying around the office. As a matter of fact, the stubs are handled in comparatively small groups and only the group with which the accountant is working, will be out of the tray, binder or box provided to house them.

Stubs are recognized in the office to be as valuable as a cheque, a note or even a bank note. It has been said by one accountant who advocates this plan that we have been using loose leaf money for a good many years, and in most cases, it is handled carefully and with due caution.

Another objection often raised to the stub plan is that it does not provide a continuous record of the customer's account.

What is the value of a continuous record?

It is useful when a customer calls to discuss his account or to prepare a statement.

It is a valuable source of credit information for the collection and merchandise departments.

Now, as a matter of fact, when a customer comes in to discuss his account, you would not carry the discussion very far without having the meter book in front of you, because for instance, the charge or consumption to which he is objecting may be due to a previous underreading or from seasonal causes which may best be answered by a comparison with a preceding period.

There are several ways of filing or

handling the stubs so that the stubs of a customer are readily available.

In Belleville, Mr. Scott uses the plan of filing all the stubs of a customer together. This immediately answers all questions as to account and credit information.

Another method is to attach to the current stub, the stub for the period in which arrears originated and also all successive stubs, until the account is again fully liquidated. This plan is based on the assumption that only accounts in arrears will ever require either a statement of the account or a discussion with the customer.

Another method frequently used, is to provide space on the current ledger stub for notations of arrears by months. In such cases provision is also made for the recording of partial payments.

Now let us say for the purpose of argument that a stub is lost or deliberately destroyed. When the outstanding stubs fail to balance with the control of the group, the amount of the discrepancy is immediately discovered. The sales audit sheet which was obtained at the time of billing may be used to determine which particular item or items of billing constitute the difference. Checking off the paid stubs to the audit sheet will eliminate all but the outstanding items. Checking off the outstanding stubs to the items remaining on the sales audit sheet will eliminate all but the items constituting the difference. Thus the missing stubs may be replaced. In actual practice this procedure is very seldom necessary as a lost stub is most unusual.

These objections suggest that the ledger plan has these advantages over the stub plan. In all other factors they are therefore equal unless it may be demonstrated that the stub plan has certain advantages not obtainable under the ledger plan.

Probably the most outstanding advantage is the speed and simplicity of cash posting under the stub plan as previously described.

The trial balance is much simpler, as only the open or unpaid items are handled. The stubs are actual duplicates of the bill, at least as to charges, and must represent the actual outstanding balance of the group.

The re-writing and heading up of ledger sheets is eliminated and a certain saving is also made in stationery costs.

Collections are materially aided as the plan separates the outstanding and the paid accounts.

Ample space is available on the stub for many partial payments and remarks.

Economy and efficiency are apparent in the stub plan. The Hydro Offices now using the stub plan would not consider returning to the ledger plan.

## Discussion

*Mr. O. H. Scott, Belleville:* We have had the stub plan ever since we have had machine billing—for three years, 1931-32-33, and the work of the ledger-keeper is so much lighter and the information is so much more easily available, that we would not care to go back to the old method at

all. I spoke to the ledger-keeper before coming to Toronto, and asked her what I could say when Mr. Summerlee read his paper. She said I might tell him we ought to get our commission, because we have been agents for selling them ever since we put in this plan, and because we have not had any person come to Belleville to look into our system, who has been thinking of putting in machine billing but has seen immediately the results that we have obtained with the Stub Plan of billing. That three years' experience has not shown us any weakness in the system at all. We have gone on and made other improvements in the meter reading cards, and so on, which have enabled us to pick up information more readily than we did before. We have yet to lose any stubs and the quickness with which we can get the delinquent accounts after the last discount day is really amazing. In a unit of 250 accounts there are possibly 20 that are not paid by the last discount date. In the ledger system you are handling 250 account cards to deal with those 20 delinquents.

Then there is the question of discussing large bills with the customer. We used to use the ledger card with an occasional reference to the meter reading books. We have passed that up entirely. Now, when the customer comes in to complain or to discuss his account, we immediately go to the meter reading books. There is all the information you need, and it will enable you to discuss with your customer kilowatt-hours instead of dollars and cents. The thing that is important in discussing his bill with the consumer is the relation of consumption to the rate. It is a thing that your customer does not know anything about,—he is interested in dollars and cents. If you can get him back to kilowatt-hours it makes it much easier.

In addition to the stub plan, we have in Belleville, with the machine billing, been obtaining information which was not available previously. The total of our service charges, our total kilowatt-hours at various rates and so on, was guessed at, if we wanted to use it, but it was never there to actually put our finger on when making recapitulation of our monthly billing. And at the end of the year when making a revenue analysis, it shows us the actual kilowatt-hours used at various rates, what we get from service charges, from discounts, and from flat-rate water heaters, the number of kilowatt-hours used, and the minimum bills.

*Mr. George Appleton, Toronto:* We handle over a million stubs in a year and we have not lost one yet, so the possibility of losing them does not seem very great.

There is one thing I was wondering about—not so much for the Toronto Hydro as the others. What is the lowest number of accounts for which it is economical to put in a billing machine? And another thing is whether this billing machine can be used for other purposes in smaller municipalities. We have the Burroughs in and it certainly is a great improvement over the hand method. By their use we have been able to increase the output per clerk.

*Mr. Summerlee:* Practically every Hydro office has some accounting

equipment. Some of this equipment was purchased several years ago, and due to different conditions, changing personnel and other reasons, it is possible that the equipment is not being applied to the best advantage.

Many offices use addressing machines only for addressing the bills. A very practical cross index arranged alphabetically and geographically can be obtained by using the machine to print on small cards which may be sorted to any sequence desired. Meter location cards may be set up in a like manner. Many other uses may be found for this equipment.

Utilities having a numerical folio number assigned to each customer, can use the wide carriage adding machine to excellent advantage in writing the cash book.

Billing machines are useful for many applications in addition to the billing work. In instances where ledger cards are used, the credits may be posted to the ledger, by the machine and a total obtained to balance with the cash receipts. The credit posting has been done with the rubber stamp method. This is a simple plan. The date of the payment is printed opposite the debit when the amount of the payment is the same as the charges. This has been generally used because of the fact that the majority of the accounts are settled in full. It has, however, the weakness that the postings are not proved until the trial balance has been taken.

This equipment is also used for writing the cash book. It is desirable to handle this individually as in some cases it is necessary to provide for electric, gas, water, merchandise and other revenue.

Most of these machines may be used to compile the data on power consumers. Practically every office has this problem and it entails in many instances considerable work to compile statistical data by the various steps of consumption, the service charges and the revenue. These data are obtained easily by the three steps of consumption. the service charge, and the gross and the net charges.

*Mr. George Grosz, Waterloo:* I would like to ask two questions. The first is: If the customer in arrears comes in after the 15th with his bill, and the meter reading book is out. how do you handle that? The second question is. Will putting in a billing machine take more help or less help?

*Mr. Scott:* You still have your stubbs even if your meter reader is out with the book. You have them filed and can always refer to them.

About a year ago the commissioners of one utility came down to see the Belleville system. They were thinking about the ledger system. I interjected the stub plan into the discussion, and one said, "Why our accountant did not say anything about the stub plan," and turning to him asked, "What do you think about the stub plan?" He said, "I was afraid to ask for it,— I thought it might follow." "Well," said the commissioner, "why not consider the whole thing at one time?"

I suggested to him that they should ask me questions in regard to the plan and that they could see how it worked. He said, "What have you in mind?"

I replied, "We have been operating since 1931, roughly. Suppose you ask for the ledger-keeper to bring you

the bills of some person you know in Belleville for that period."

"Well," he said, "Who is the chairman of your commission? Ask the ledger-keeper to get the stubs representing the chairman's account for 30 months."

I noticed he looked at his watch. "It is just 3 o'clock." I did not recognize for a moment what he was doing, but the ledger-keeper came back in one minute and fifteen seconds with all the stubs for 30 months. That shows you how efficient the system is.

As regards the help necessary to take care of our system: when we put it in, we were to the point when we had to get more help. We used that argument to get the machine in—we had to have the machine or extra help. Since the machine has been in the office we have been finding the work much easier: we obtain a great deal more information than before, but the ledger-keeper and the rest of the staff are not working nearly as hard, and we are more accurate in our work and we do not have to hunt for accounts unpaid.

*Mr. P. B. Yates, St. Catharines:* We have mechanical billing. We use the ledger card and are getting very good satisfaction from it. Of course it does mean handling a lot of cards. Whenever you go to check up accounts in any particular district you have to go through them all.

The stub plan was not put up to me when I changed over. I do not know whether I would have considered it or not. I would hate to have to change now.

*Mr. C. A. Walters, Napanee:* When we considered billing machines we had in mind the ledger card system. We discussed the matter thoroughly and finally decided to put in the stub plan, and I may say that we are absolutely satisfied. If we were asked to advise small municipalities what to do, we would have no hesitancy in suggesting the stub plan. The question of transferring from existing ledger systems, is different and I would not say how we would feel if we had to do that.

*Mr. R. M. Bond, H.E.P.C. of Ont.:* I would like to ask Mr. Walters what number of inquiries he has, particularly concerning accounts by customers. Does the system lend itself to obtaining that information?

*Mr. Walters:* The percentage of questionable accounts and complaints is very small, and we have plenty of time to look up the information required. We have no difficulty in that respect. The meter record books, as Mr. Scott says, tell the whole story. The discussion of kilowatt-hours is an important item as compared to dollars and cents. The whole story is there on your meter record sheet. I question if there is even one enquiry of that nature a day.

*Mr. J. R. McLinden, Owen Sound:* We have the ledger card system working satisfactorily for us. I believe we are saving about 40 per cent. of labour and we have no trouble with accounts whatever. We have no thought or desire for anything better.

*Mr. C. E. Brown, Meaford:* Would any municipality recommend a change from the ledger system to the stub system?

*Mr. Bond:* I am greatly interested

in that question. We have no intention to induce any municipality to buy or install any type of equipment. It is the job of the manager to decide what really applies to his own particular circumstances or organization. What we want to do in this meeting—what the accounting committee are desirous of doing,—is to give the latest information on billing methods, in order to help any of the municipalities who are contemplating installation of equipment. We are not advocating a change from the ledger to the stub system, although if you have a Burroughs machine, that can be accomplished with very little additional expense if the time ever came when you desired to make that change. We do feel, however, that the stub plan is a step in the right direction, and we have had good success in the various municipalities that are using it. It might be interesting to note that the stub plan of billing is adaptable to small municipalities of one, two or three hundred customers, as well as to those having mechanical billing, through an adaptation of typewriter methods of billing, which I hope we will have time to discuss later. We are trying to present to the municipalities a comprehensive scheme of billing that will take in, not only the larger ones, but the smaller ones as well—to give them something that will enable them to improve billing and keep control of their revenue accounts.

# O.M.E.A. *and* A.M.E.U. Convention

# *at*

# Ottawa

## June 28, 29 *and* 30, 1934

# Electrical Service to Gold Mine — Nipigon District

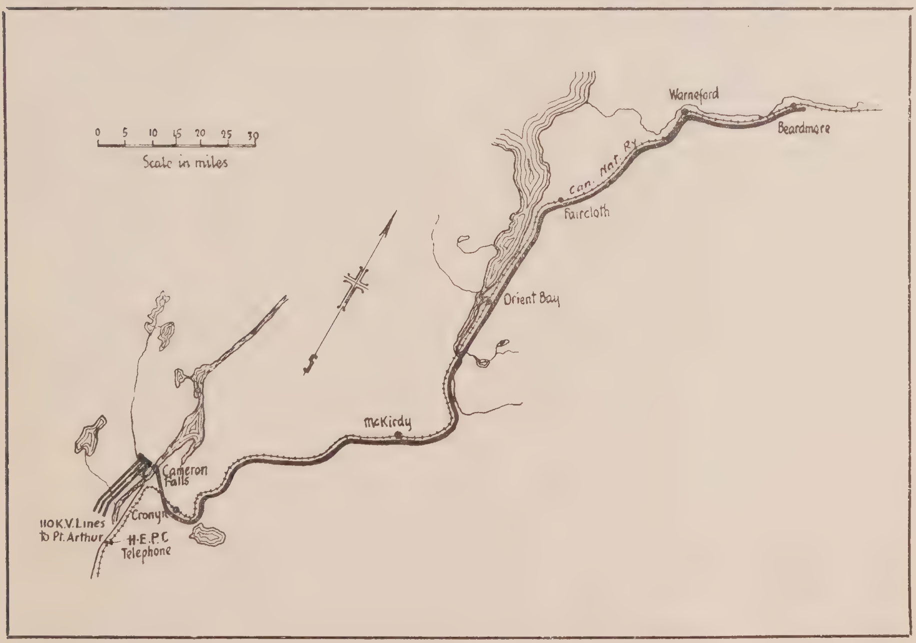
By A. E. Davison, Transmission Engineer, Electrical Engineering Dept., H.E.P.C. of Ont.

LATE in May, 1933, the Northern Empire Mines, Limited, at Empire, Ontario (formerly Beardmore) negotiated a supply of electrical energy already available at the Cameron Falls development of the Hydro-Electric Power Commission on the Nipigon River to be delivered to that Company some 48 miles east along the right-of-way of the Canadian National Railways. Funds were provided for the building of a 33 kv. pin-type transmission line to the mine. On May 31st, instructions were issued for the building of this line and work in the field commenced on June 15th.

The territory between the power plants and the mine is quite undeveloped except for the railway and a limited amount of lumbering during the war. The most available route, although by no means the shortest, was to use the cleared right-of-way of the railway. A permit for occupation was granted by the Canadian National Railways, involving a co-ordination of the telephone and telegraph lines of the Railway Company with the proposed power line.

### Fast Work

Surveys, consisting largely of staking pole locations and taking of mea-




*Map showing route of 33 kv. line, Cameron Falls to Empire (Beardmore).*

*Scene along C.N.R. right-of-way showing 33 kv. line construction.*

surements between existing and proposed poles, were necessary before construction and co-ordination calculations for communication lines could commence. However, by the end of August the line was completed and ready for service in less than 45 working days. This time is remarkable, considering the fact that it was necessary during that time to assemble materials, some of which came from British Columbia, as well as make surveys and organize construction gangs and transportation. The leasing of boarding cars from the railway company, the moving of camps on wheels, so that work need never be more than 2½ miles from camps, and the leasing of gasoline-powered cars to transport men and materials locally, were major items in the rapid construction of this work.

### Type of Construction

A triangular configuration was used, there being a pole top pin with other phases at ends of a long arm (10 ft.) located some 18 inches below the top of the pole.

This construction is typical of a tendency to abandon any protection there may be due to earthed wires being erected above the circuit, in favour of the resulting lower first cost. Guys and other metal connections are kept clear of the arms. By providing these clearances considerable use is made of wood insulation.

### Special Transpositions

Construction work had made considerable progress before the locations of transpositions in the power lines could be determined. This necessitated a special type of power transposition involving the cutting and dead-ending of the wires each mile, or thereabouts. This quite objectionable practice could not be avoided because of the time limits set for the delivery of the power.

### Communication Facilities

Usually it is desirable to install a communication service in order to satisfactorily operate a service of this kind fifty miles from the source of power. In this case, it was decided

*33 kv. entrance to mine transformer station.*

that first costs should be kept at a minimum and that the communication services of the railway organization should be used until it was found that they were inadequate or uneconomical.

### System Connections

This line now forms part of a generating and transmission system which extends from Empire, on the east, to Westfort (Fort William), a distance of over 130 route miles. This line and the associated 110,000 volt lines (250 circuit miles) distribute power from two generating plants on the Nipigon River which have a capacity of approximately 130,000 h.p. Excepting the power used at Empire and a somewhat similar load at Nipigon, all of the output of the generating stations is consumed in the vicinity of Port Arthur and Fort William.

### Tabulation of Transmission Line Characteristics

33-Kv., 60-cycle service to Northern Empire Mines Limited, at Empire, Ontario.
Length—47.50 miles
Nominal span—200 ft.
Maximum operating voltage—35,000 volts
Frequency—60 cycles
Date originally placed in service—September 23rd, 1933

Number, type and location of lightning arresters—2 Westinghouse L.V. arresters, 50,000-volt, located at each end of line.

Neutral—Transformers delta-delta connected—no ground on 33-kv. side.

Location of neutral grounds—None (isolated system)

Conductors:—

Size and material—No. 4 solid copper

Ultimate strength—2,000 pounds.

Maximum design tension—900 pounds.

60 deg. fahr. tension—176 pounds.

Equivalent sag in nominal span—4 ft. 6 inches.

Insulators—Pin type—35,000-volt, two-piece rating and wood pins.

Insulators—dead-end—(at transpositions also) 10 in. by 5 in. ball and socket.

Number of units per string and type—2

Number of strings in parallel —None

Flashover protection—None

Ground wires —None

Supports:—

Type and material—Single wood pole with some wood and some metal pole top pins.

Total number in line—1,275

Designed for loading of ½ inch ice, 8 lb. wind, 30 deg. fahr.

Telephone service—None.

*This picture records one of the many extraordinary incidents arising during the surveying and construction of pioneer lines. A member of the staff during an inspection trip on the C.N.R. east of Lake Nipigon along the line serving Northern Empire Mines, Limited, snapped the picture shown. When passing a small lake beside the right-of-way, a moose and calf were seen swimming across the lake. The operator of the gas car said, "She will likely come out about here." The car was stopped; the photograph shows everyone hurrying.*

# Fusion Welding

## The Testing and Inspection of Arc Welding

**By W. D. Walcott, Inspecting Engineer, H.E.P.C. Laboratories**

FOREMOST among the important considerations of arc welding is the testing and inspection of the finished weld. The question has often been asked by engineers and others: "How can we tell a good weld?" A good weld may be defined as one which is free from flaws or imperfections and possesses approximately the same physical characteristics as the parent metal.

Many failures have occurred from poor welds that were made without adequate supervision or proper inspection. These failures could have been avoided if supervision and inspection had been carried out, and they are to a degree responsible for the conservatism shown in many quarters in adopting welding as a method of fabrication in the various branches of the steel industry.

Until comparatively recently, welding was used largely as a means of repairing broken structures, and practically no attention was paid to the features of inspection. Within the last ten years the scope of welding has increased and it is now being used as a means of fabricating structures which were previously riveted or cast. On this account more attention has been paid to technique and inspection, with the result that great improvements have been made in the quality of the welds produced.

In the inspection of welds, there are three important factors which decide the quality—materials, personnel, and workmanship; and good welds can only be produced by the combination of skilful welders, suitable materials, and correct technique. We will now consider these points in detail.

### Materials

The Inspector must first satisfy himself that the materials with which the work is to be done are of such a standard that they will produce the quality of work required.

*Welding Machines*

First in importance is the welding machine which should be capable of supplying a constant and even flow of current at the proper voltage under the most severe working conditions. As a general rule, direct current machines give the best satisfaction.

*Parent Metal*

Next, there are the component parts of steel or iron to be welded, sometimes called the "parent metal," which may be either a casting or a rolled steel shape. They should conform to specifications for steel of weldable quality. The controlling constituent in these steels is the carbon, as steels of carbon content higher than about .25 per cent. are very difficult to weld with the arc.

*Electrodes*

The electrodes in addition to generating the heat when the arc is drawn, provide the filling material in the weld. These electrodes may be of the bare wire type, the lightly coated type, or the heavily coated type, and each of these must satisfy

certain specifications. The bare electrode produces weld metal inferior in physical properties to mild steel. Due to the absorption of oxygen and nitrogen from the air, oxides and nitrides are formed in the weld metal and these give it brittleness and lack of ductility. The lightly coated electrodes are perhaps a little better in this respect than the bare electrodes and are somewhat easier to manipulate than the bare electrode during welding. The heavily coated electrode produces a weld deposit that has much the same physical characteristics as mild steel, and should be used on the more important types of work. On account of their heavy covering, there is a danger of slag inclusions in the weld if correct technique is not employed.

The polarity of the different types of electrodes is a very important matter because the use of wrong polarity will always result in a poor weld. The bare and lightly coated electrodes require straight polarity in which the electrode is on the negative side of the circuit and the work is on the positive side. The covered electrodes require reverse polarity in which the electrode is on the positive side of the circuit and the work is on the negative side.

*Tests for the Electrodes*

Tests for electrodes may be divided into the following classes:

1.—Physical and chemical tests of the rods.

2.—Physical tests on the deposited metal, which include specific gravity, tensile strength, elongation, and bend.

3.—Microscopic examination of characteristics of deposited metal.

4.—Observation of the behaviour of electrode during deposit.

Space does not permit us to enter into the details of each of the tests. They are covered in specifications such as those issued by the American Welding Society and the American Society of Mechanical Engineers.

### Welders

The part played by the human element is perhaps the most important and at the same time the most variable. The inspector must satisfy himself that the welder possesses the necessary skill to do welding of the quality required and must see that the welder always maintains that standard. In order to do this, the welder must make a standard test piece. For ordinary work these may be divided into two main types, namely:

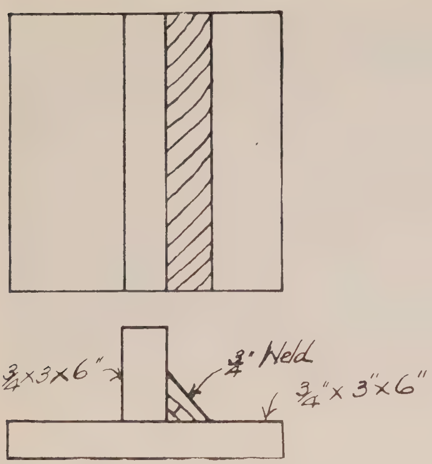
1. Bend Test
2. Tension Test

There are, however, other special tests such as those required by the code of welding as prescribed by the American Society of Mechanical Engineers, in their rules for construction of unfired pressure vessels.

A description will now be given of types of these test pieces which have been found satisfactory in practice.

*Welding Test Pieces*

Tee Bend Test—A piece of steel plate ¾ in. by 3 in. by 6 in. long is welded to another piece ¾ in. by 6 in. by 6 in. long, forming a T section when the weld is complete. The weld should be made in the horizontal plane on one side only, using a 3/16 in. diameter electrode, and a current of about 190 amperes. The test piece




*Tee Bend Test Specimen.*

is then broken with a sledge hammer and if the weld is good, the fracture should occur through the throat of the weld at an angle of approximately 45 deg. to each surface. The quality of the metal in the fracture and the degree of fusion may be readily observed. These depend on the welder's ability to fuse successive layers of weld metal together without depositing pockets of slag and to make a weld free from porosity and other defects.

If the weld does not break through the throat and breaks out from the parent metal along the toe, it is conclusive evidence that poor fusion has been obtained, and that the welder's work is of poor quality.

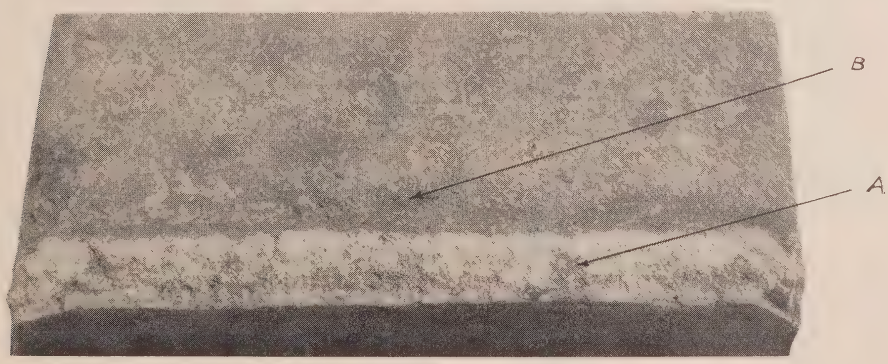
### Tension Test

The tension test piece is in the form of a butt weld made with two pieces of 9 in. by 12 in. by ½ in. steel plate bevelled at 45 deg. on one edge of each plate, thus forming an angle of 90 deg. when the two plates are ready for welding.

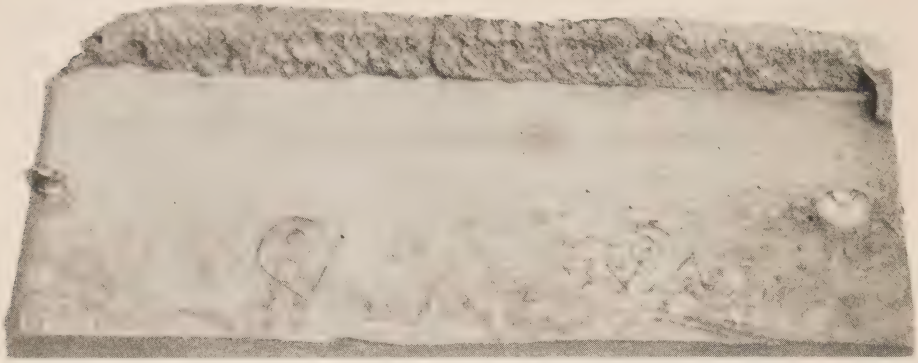
The welder should make these butt weld test pieces in four different positions, corresponding to the four positions that are usually met with in actual welding. They are as follows:

1. Flat Horizontal
2. Vertical Vertical
3. Horizontal Vertical
4. Overhead

1. In the flat horizontal type of welding the parent metal lies in the horizontal plane and the weld metal is deposited in the horizontal plane.




*Tee Test Piece.—Note the dark areas similar to A along the weld. They are slag inclusions and are the result of faulty technique. At B we have indications of spattering which continue along the weld. They are the result of poor control on the part of the operator.*



*Tee Test Piece.—Note the even homogenous structure and the freedom from slag inclusions on the weld.*

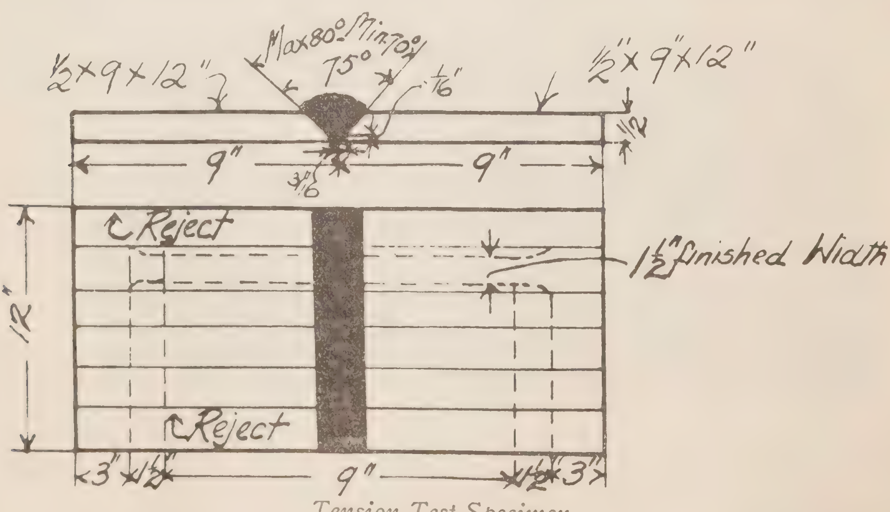
2. In the vertical vertical type, the parent metal lies in the vertical plane and the weld metal is deposited in the vertical plane.

3. In the horizontal vertical type, the parent metal lies in the vertical plane and the weld metal is deposited in the horizontal plane.

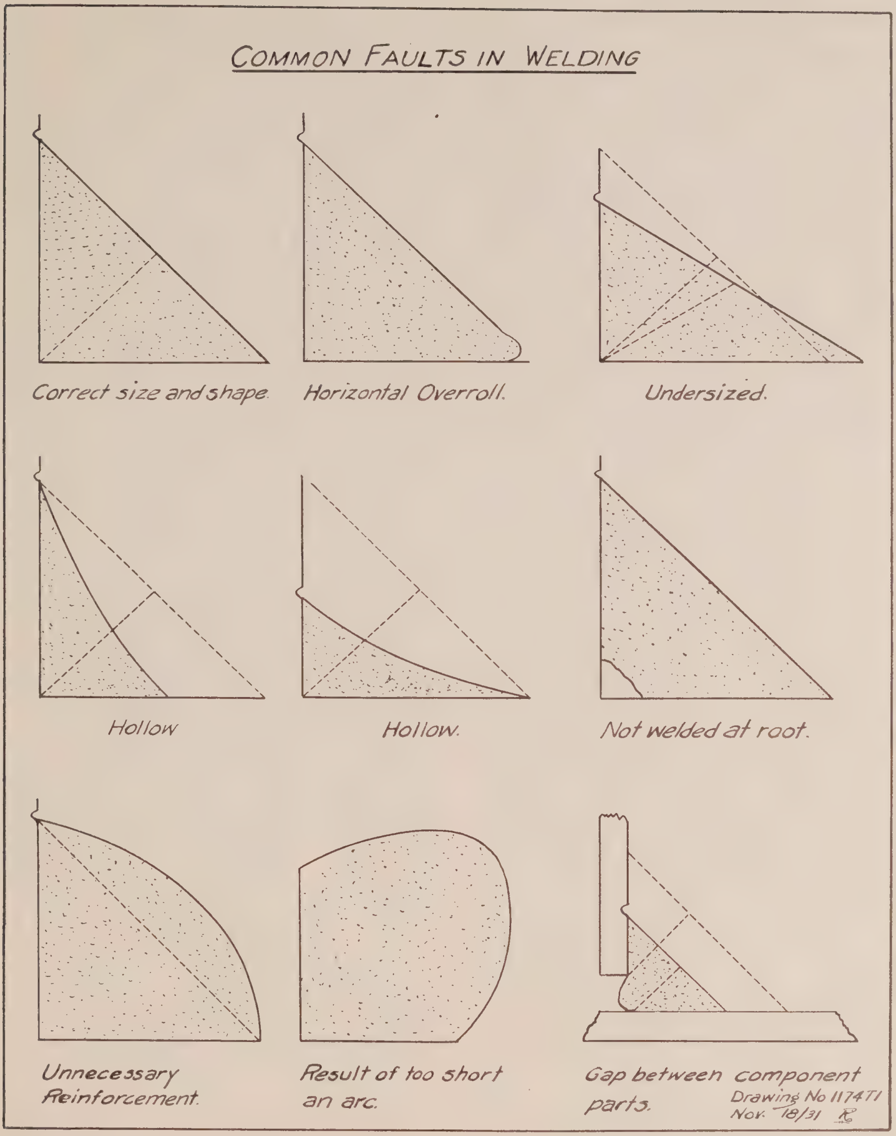
4. In the overhead type, the metal is deposited in an upward direction. Due to the fact that the forces which deposit the metal must overcome the forces of gravity, cohesion and surface tension of the electrode, it is much more difficult to make a good weld, and for this reason overhead welding is only used where it is absolutely necessary.

Test pieces should be made under conditions similar to those encountered in the actual welding on a job.

After welding, the plates are machined to 1½ in. by ½ in. sections and then after discarding the two outside coupons test is made on the others. Depending on the class of work, a minimum of from 45,000 lb. per sq. in.




*Tension Test Specimen.*




to 55,000 lb. per sq. in. is required for each coupon.

It is the custom in large plants for welders to make test pieces at regular intervals and operators whose test pieces do not satisfy the requirements are not allowed to continue welding.

### TECHNIQUE

In order to be sure that the best practice is being followed by the welder, it is absolutely necessary for the inspector to watch him closely while he is welding. The importance of holding a short arc and using cor-

rect voltage and current for the type of rod and thickness of plates used cannot be emphasized too strongly. The degree of fusion can be easily seen, and the skill of the welder can be judged by observing whether or not he is holding the rod correctly, namely—vertical to the face of the pool or at a wrong angle, and in extremely unsatisfactory cases, parallel with the pool just melting the rod and running the hot metal ahead of him. If the two sections are of uneven thickness, the arc should be played more on the heavier section than on the other, in order to obtain proper fusion. For every welding operation there is a correct technique, and it is only by application of the correct methods, along with the use of suitable parent metal and good electrodes, that the best results will be obtained. It might be pointed out that the technique for covered rods is quite different from that which can be successfully applied when using a bare electrode, and poor welds may be produced with covered rods because the welder has used incorrect technique.

Among the important questions to be considered under the heading of "Technique" is the relieving of residual stresses. These stresses are locked up in the weld due to the contraction which takes place as a weld cools. Under certain conditions these stresses may be of considerable magnitude and are in some cases sufficient to cause cracks in the welds.

Among the commoner methods used in stress relieving is the "step back" method of welding which reduces the contraction stresses. In this method the area to be welded is divided into short sections. Welding is commenced about eight inches from the right hand end of the seam and the direction of travel is from left to right. When this section is completed another section is started eight (8) inches to the left of where the first section commenced. The weld is continued until union is made with the first section. This process is repeated until the whole seam is welded. The same direction of travel is used throughout the entire length of the weld as was used in the first section. In this way the cumulative effect of these residual stresses is reduced.

Stress relieving may also be accomplished by peening each bead in the weld immediately after it has been laid. A blunt caulking chisel or similar tool has been found satisfactory, the peening being accomplished by sharp light blows while the metal is still hot.

Perhaps, however, the most efficient method of stress relieving is to heat the welds uniformly to a temperature somewhere between 1100 and 1200 deg. fahr. It should be raised slowly until the desired temperature is reached and then should be held for at least one hour per inch of thickness; and then the structure should be allowed to cool slowly in the air. The structure should be supported in such a way that no warping or distortion will take place.

### Visual Inspection

Coupled with observation of technique while the metal is being deposited is the visual inspection after the weld is complete. Quite often the external appearance is the only evidence on which an inspector can judge its quality. While it is true that

there are certain visible characteristics which indicate a good or a bad weld, it is impossible to judge the quality of a weld with any degree of certainty without knowledge of the details of the technique used in making it.

Lack of penetration into, and fusion with the parent metal, termed "overlap" or "over-roll" is shown by a rounded edge of deposited metal lying on top of the parent metal. This is caused by either holding too long an arc, or by the use of current too low for the diameter of the electrode used, or by a combination of both. A deep depression line between the boundary of the deposited metal and the parent metal is termed "undercutting" and results in weakening the weld as well as being a ready source for the start of fatigue cracks. It is caused by the use of too high a current for the size of electrode used. Too much current will also cause spattering, which in addition to wasting the electrode, will result in the deposit of burnt weld metal.

Other common defects are cracks, slag inclusions, and porosity.

The degree of penetration can be estimated by cutting out a V section of a weld with an acetylene torch and then melting the weld metal beginning from the outer layer. If there is poor fusion to the parent metal the last layer will curl up like a sliver and the parent metal will present a black charred appearance.

Chipping small lengths of cross sections at intervals along a weld will tell its quality. Slag inclusions, porosity and other defects may be observed. Welds which have a hard surface offer great resistance to a chipping hammer, are usually brittle and indicate that too long an arc was held during welding.

Welds should be neat in appearance and should show uniform sections of the proper size. The size of fillets can easily be checked by means of simple gauges, which should be used by both welders and inspectors.

All defective and doubtful welds should be chipped out and rewelded.

The following is a list of the chief causes of poor welds:

1. Using an unsuitable or a defective welding machine.
2. Using parent metal that is unsuitable for welding.
3. Using electrodes of poor quality.
4. Poor preparation of joint.
5. The use of incorrect voltage and current values for size of electrode and thickness of parent metal.
6. Holding too long an arc during welding.
7. Incorrect rate of electrode advance during welding.
8. Incorrect manipulation of electrode and incorrect sequence of laying beads.
9. Wrong polarity.
10. Poor ground.
11. Neglecting to remove scale from surface of welds when they are composed of more than one layer.
12. Neglecting to remove dirt, scale or paint from parent metal before welding.
13. Failure to relieve residual stresses.

### Inspection by Radiographs

Within the last two years, the use of radiographs has become part of the

routine inspection of welding in some of the plants in the United States and Europe which specialize in the welding of heavy plate sections. The X-ray and the gamma-ray are utilized for taking photographs which show the condition of the deposited metal in the interior of the weld. The use of this apparatus is confined chiefly to the inspection of high pressure vessels such as tanks, stills, boilers, and similar apparatus where failure would perhaps result in the loss of human life. Welds as high as 4 in. in thickness have been explored by the X-rays and it is claimed that the gamma-ray will penetrate as much as 12 inches.

Apparatus of this description is still high in cost and its use is limited on this account. It is possible that with the advances that have been made in the use of X-ray and radium some cheaper effective method will be developed which will bring the cost of radiographs so low that comparatively small shops may be able to utilize it.

### Laboratory Methods of Inspection

Space does not permit a detailed discussion of these methods in this paper. It will be sufficient to say at the present time, that while they have features which are meritorious, these devices are not suitable for general routine inspection. It may be that further study and research will bring them to such a stage of perfection that they can be used for general commercial inspection.

Among these methods the following may be mentioned:

(a) The Stethescope.
(b) Magnetic Devices of various kinds.

### Conclusions

Much criticism has been made against welding as a general means of fabrication because there is not yet any simple non-destructive method of telling whether a weld is good or bad after it has been completed. Attempts have been made to put tools into the hands of a welding inspector corresponding to the hammer used in testing rivets, but it would seem that just as the engineer has had to change his designs to suit welding, so must the inspector devise new methods of inspection which will give satisfactory results.

Up to the present the most satisfactory methods of obtaining good welds appear to be the use of suitable materials, and efficient workmen along with careful supervision at all stages of fabrication.

The component members of a welded structure should be carefully prepared and properly fitted. Welders of proven ability should be employed whose technique should be continually checked. If these conditions are enforced a competent inspector should have reasonable assurance of the quality of welds produced.

# Association of Municipal Electrical Utilities

## Minutes of Executive Committee Meeting

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the office of the Hydro-Electric Power Commission of Ontario, Toronto, at 2.00 p.m. on Tuesday, April 3rd, 1934. Those present were: Messrs. W. R. Catton, *Chairman*; O. M. Perry, D. B. McColl, O. H. Scott, J. R. McLinden, P. B. Yates, D. J. McAuley, T. W. Brackinreid, C. A. Walters, T. J. Hannigan, and S. R. A. Clement.

It was moved by Mr. O. H. Scott, and Seconded by Mr. D. B. McColl "THAT the Minutes of the Executive Committee meeting on October 16th, 1933; of the Convention of January 31st, and February 1st, 1934; and of the Executive Committee meeting on January 31st, 1934, be taken as read and approved."—*Carried.*

This meeting was for the purpose of considering plans for the summmer Convention of the Association to be held at Ottawa on June 28th, 29th and 30th, 1934.

The Secretary read that part of the Minutes of the Executive Committee meeting of January 31st, 1934, recording the decision to go to Ottawa and explained that he had found the earlier dates than those suggested by the Chateau Laurier, were not available on account of previous committments and that the dates suggested had therefore been confirmed.

The time at which meetings should be held during the Convention was discussed, and it was moved by Mr. P. B. Yates, and Seconded by Mr. O. M. Perry "THAT sessions of the Association of Municipal Electrical Utilities be held on the mornings—to be called at nine o'clock."—*Carried.*

The question of Convention luncheons and dinners was considered, and it was moved by Mr. O. M. Perry and Seconded by Mr. T. W. Brackinreid "THAT there will be no official luncheons during the Convention," and "THAT there will be two organized evening meals, at 7.00 o'clock, not to cost over $1.50 for each meal, per person."—*Carried.*

It was moved by Mr. P. B. Yates and Seconded by Mr. O. H. Scott "THAT Mr. T. J. Hannigan give an address at one of the evening meals on 'Incidents during the early days of Hydro'."—*Carried.*

It was agreed that Mr. Hannigan's address would be on the first evening of the Convention, following a short musical programme, and that on the second evening there would be a short musical programme followed by dancing.

Mr. D. B. McColl, Chairman, Papers Committee presented a report suggesting papers and discussion for the Convention, of which the following were chosen:—

*Thursday Morning—June 28th—*

- A paper on off-peak loads.
- A paper on gaseous discharge lamps.

*Friday Morning—June 29th—*

- A paper on merchandising.

A discussion on the Standard Interpretations of Rates.

Also on Thursday morning there will be a special session on Accounting arranged by the Committee on Accounting and Office Administration.

Mr. McColl moved the adoption of his report, which was Seconded by Mr. J. R. McLinden and *Carried.*

Mr. O. M. Perry presented a report from the Convention Committee regarding proposed entertainment during the Convention and asked for an appropriation for that purpose. It was moved by Mr. D. B. McColl, and Seconded by Mr. J. R. McLinden "THAT the Convention Committee be granted $300.00 to provide entertainment during the Convention."—*Carried.*

It is proposed to provide entertainment for the ladies on the afternoons of Thursday and Friday, and to arrange a trip to some power development on Saturday morning. Mr. T. J. Hannigan was asked to take up the question of ladies' entertainment with the Mayor of Ottawa, and the Secretary to write the Board of Trade and The Industrial and Publicity Commission of Ottawa for suggestions.

The names of Messrs. S. E. Preston, George A. Conn, E. B. Easson, and C. E. Hodgson, were presented as applicants for associate membership. It was moved by Mr. O. H. Scott, and Seconded by Mr. D. B. McColl "THAT these be declared elected as Associates, subject to the approval of the Association at its next General Meeting."—*Carried.*

The meeting then adjourned.

## Radio Inductive Interference

*Supplement A to Bulletin No. 2, "Radio Inductive Interference", by Mr. H. O. Merriman, p. 41, published by Radio Branch, Department of Marine, —15 cents.*

In 1932, the Department of Marine issued Bulletin No. 2 as an instruction book for Government Radio Inspectors in which the causes of radio interference are explained. This work is now amplified by the recent issuing of Supplement A to the above Bulletin in which the improved investigation equipment is described with photographs showing the manner in which this equipment is installed in their motor cars. There are also wiring diagrams given for this equipment.

One feature of the portable testing equipment is the special device for sense finding used in locating faults on high tension lines, which has proven a great aid.

This Supplement also deals with the neutralized radio transmission lines to be used with different types of aerial systems. There is a chapter on surge traps giving some formulae for calculating the proper values of inductance and capacity.

In the final chapter are some good suggestions for the investigation of interference on public utilities' lines. This is a feature of the work of the Department concerning which a great deal of information has been obtained recently and some striking advances have been made in developing methods of test to be used in the search for sources of interference.

This issue is a very desirable addition to the original work on radio inductive interference.—*F.K.D.*

THE
# BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

## Important Statements re Hydro

IN view of reiterated misrepresentation respecting various important aspects of the work of the Hydro-Electric Power Commission of Ontario on behalf of the co-operating Hydro utilities, Chairman Hon. J. R. Cooke, on April 20th, announced that he would issue some Memoranda presenting explanatory statements in order to assist those interested in the Hydro undertaking intelligently to defend their property and interests.

The Chairman's Letter, as well as the memoranda—of which four have thus far been published—speak for themselves.

### CHAIRMAN'S LETTER

*To Those Associated with the*
*Work of the "Hydro" Utilities:*

ALTHOUGH from its commencement Ontario's municipally-owned Hydro undertaking has not been free from misrepresentation and has had to meet numerous attacks, yet during the last few years special effort has been made through various agencies to discount the achievements, and to place some of the affairs under the administration of the Hydro Commission before public attention in an unfavorable light. The Hydro-Electric Power Commission has dealt specifically with some of these misrepresentations in order that the citizens of the Province whose money is invested in the Hydro undertaking would have removed from their minds the disturbing effects that have been produced by adverse propaganda.

The Commission and, I believe, the local utilities have recognized and appreciate the valuable assistance that has been rendered by the Press of this Province in presenting various statements and explanations which the Commission from time to time has issued.

Of late the Commission has been confronted with a special difficulty. The methods recently used by those who disparage Hydro consist, not only

## CONTENTS

Vol. XXI MAY, 1934 No. 5



of misrepresentation, but of resurrection and persistent repetition of misstatement respecting Hydro operation, even after the original misrepresentations have been corrected. Only by correspondingly persistent exposure of the misrepresentations that are being made, can the Hydro undertaking, under attacks of this nature, be safeguarded from impairment of public confidence.

To illustrate: Three matters respecting the purchase of the Madawaska properties, the purchase of the Dominion Power and Transmission properties, and the purchase of power by the Commission from the Beauharnois Light Heat and Power Company were subjected to unfounded criticism. On examination by a Royal Commission of Ontario Supreme Court judges, the allegations and innuendos that had been made respecting these matters were found to be entirely groundless. Nevertheless, the criticisms and misrepresentations continue to be repeated, evidently in the belief that the general public has forgotten the facts as proven in evidence before the Royal Commission.

If the findings of the eminent judges composing the Royal Commission are not entitled to confidence and respect, to what, may I ask, can the people of the Province look for a just determination of facts which they are unable individually to examine and verify.

Enclosed herewith are copies of a summary of the Royal Commission's findings that was given in response to questions at the recent Session of the Ontario Legislature. May I suggest that you will be performing a public service of real value by handing these to those interested in your Hydro utility and by keeping one of these copies at hand, and making appropriate reference to it whenever the matters involved come under public discussion?

I may add that I hope, in the near future, to send you further material containing suitably summarized factual statement that will, it is believed, be of assistance in enabling you, as occasion may arise, promptly to recognize and deal with misrepresentations harmful to the people's Hydro undertaking. There are indications pointing to a renewal of intensified effort directed against

this public institution. It is hoped that you may see your way clear to give Hydro matters further personal attention and assist in maintaining confidence in this great co-operative undertaking that has been so beneficial to the public of this Province, and the continued development of which is so essential to the advancement of our social, industrial and general welfare.

Yours very truly,

J R Cooke

Chairman

*Toronto, April 20, 1934.*

## MEMORANDUM No. 1

### Re: Report of Royal Commission on Madawaska and Other Hydro Matters

*ALTHOUGH misrepresentations that have been made respecting important features of the work of the Hydro-Electric Power Commission of Ontario have been publicly corrected, there persists an effort on the part of some to resurrect such matters and re-present them as though they had not already been fully and satisfactorily dealt with. The Commission has been concerned at the persistent repetition of misstatement, and has concluded that public assurance of the facts relating to the people's Hydro undertaking can be maintained by making available, in concise form, official corrective and explanatory statements that have been presented dealing with various issues that have been raised.*

*The statement which here follows deals with certain matters relating to the purchase by the Commission of the Madawaska properties, to the purchase of the Dominion Power and Transmission properties and to the purchase of power by the Commission from the Beauharnois interests. It is based upon the Report of the Royal Commission of eminent Ontario Supreme Court Judges which, at the request of the Government, examined the evidence and submitted findings after having held extensive Hearings at which all interested parties were publicly urged to appear and present any factual evidence within their possession.*

*In the Ontario Legislature on March 26th, 1934, the Honourable Member for Peterborough County, Mr. T. P. Lancaster, asked four questions relating to the foregoing matters, and the Chairman of the Hydro-Electric Power Commission, Hon. J. R. Cooke, on March 28th, 1934, replied. The questions and the replies, which speak for themselves, are as follows:*

**Question 1.** What procedure was followed by the Royal Commission to ascertain the facts?

**Reply.** Counsel representing the Aylmer Public Utilities Commission, Mr. C. Mortimer Bezeau, Mayor of the city of Kitchener; Mr. Mitchell F. Hepburn, M.P.; Mr. W. E. N. Sinclair, M.L.A., K.C., and Mr. H. C. Nixon, M.L.A., appeared before the Commissioners and were given full liberty to cross-examine witnesses and to have witnesses subpoenaed who might, in their opinion, give relevant evidence. The Commissioners publicly requested persons having any relevant information to submit the facts so that they might be investigated. The Hydro-Electric Power Commission produced voluminous papers and records and its disclosure and production of documents was complete. The original Commissioner, the Hon. Mr. Justice Middleton, appointed Counsel to assist in the investigation and his services were continued by the subsequent Commissioners, Hon. Mr. Justice Orde and Hon. Messrs. Justice Riddell and Justice Sedgewick.

**Question 2.** What was the finding of the Commission regarding the propriety of the payment by the Hydro-Electric Power Commission of Ontario to one John Aird, Jr., of the sum of $50,000 in connection with the purchase by the Commission of the M. J. O'Brien power interests on the Mississippi and Madawaska rivers?

**Reply.** In view of the proven facts that it was made manifest by the owner of the property that Aird's claims must of necessity be settled, O'Brien mentioning 2½ per cent as the proper amount to be paid Aird; and that the Hydro-Electric Power Commission's engineering staff were unanimous in the proposition to make an investment of $1,850,000 as the "total cost of the property," and whether $50,000 of that amount were paid directly to the owner or to the person he had stipulated "should receive consideration" was a matter of perfect indifference, the Royal Commission found that:

> "On the facts proved beyond controversy we have no doubt whatever of 'the propriety of the payment by the Hydro-Electric Power Commission of Ontario to John Aird, Jr., of the sum of $50,000 in connection with the purchase by the Hydro-Electric Power Commission of Ontario of the M. J. O'Brien Limited power interests on the Mississippi and Madawaska Rivers' and so respectfully report."

**Question 3.** What was the finding of the Commission regarding the payment of $125,000 by the Beauharnois interests to John Aird, Jr., and the relationship, if any, of this payment to the purchase of power by the Hydro-Electric Power Commission of Ontario?

**Reply.** The Royal Commission after examining the evidence concluded that Aird did not receive the money with any intention that it should be passed on to any political party or that it should have any effect on the purchase of power by the Hydro-Electric Power Commission of Ontario, and the

Royal Commission stated "it clearly had no such effect". The Commission found that

> "while the payment of $125,000 was made to Aird it had no relation to the purchase of power by the Hydro-Electric Power Commission of Ontario."

**Question 4.** What was the finding of the Commission regarding the purchase by the Hydro-Electric Power Commission of the property, assets and undertaking of the Dominion Power and Transmission Company, Limited, and the price paid for these properties?

**Reply.** The Royal Commission, having considered the engineers' report that a 200,000 horsepower peak-load plant could be erected and so co-ordinated with the Hydro system as to warrant the Commission in paying $21,000,000 for the Dominion Company's assets, treating the radial railways as having a scrap value only, which report was concurred in by the auditor and financial adviser of the Hydro-Electric Power Commission, found as follows:

> "The purchase of the Dominion assets and undertaking resulted in many important advantages to the Commission. It made possible the production of peak power at a lower cost than it could be supplied by any other means; it prevented the undertaking being acquired by interests unfriendly to Hydro, a real menace at that time; it did away with the keenest possible competition in a large and important area of the Province; it eliminated the duplication of plant and services on highways; it stopped the installation in the same area of equipment for 25-cycle current for Hydro customers and 66⅔-cycle for Dominion, a condition that made co-ordination of the two systems more difficult as time went on; it prevented the Dominion Company making contracts for power and expending large sums on proposed works which would increase the purchase price at a later date without any corresponding benefit to the Commission as a purchaser; and it also prevented competition between the two corporations for water that may in the future become available from Lake Erie."
>
> "The operation of the properties independently by the Hydro shows a surplus after paying interest on purchase price, operation and maintenance charges, including those of the electric railways. The radial lines have been abandoned as contemplated when the purchase was made."
>
> "We beg to report that after a most extensive search no trace was found of a single transaction in the Company's shares by any one having confidential information."
>
> "We unhesitatingly find that the purchase in the circumstances existing at the time was in the public interest; was made after full and adequate investigation; was reasonable as to price and was not prompted by any motive other than the public good."

In its final report the Royal Commission, after reviewing the evidence and presenting its specific findings in regard to the questions submitted to it, added a general finding:

> "We find that in respect of the matters inquired into the business and dealings of the Commission and its staff have in every respect been conducted on the highest business principles and with great skill and rectitude."

---

## MEMORANDUM No. 2

The Introduction to Memorandum No. 2 is as follows:

*DURING his long term of office as Chairman of the Hydro-Electric Power Commission of Ontario, Sir Adam Beck, on many occasions, reminded the citizens of this Province of the great asset they possessed in the staff of the Commission, as well as in the staffs of the local electrical utilities, and he insisted that the fullest confidence should be reposed in the staff and that they be encouraged to devote their capabilities and thought to the development of the undertaking with which they were identified. Sir Adam encouraged the members of the staff as they came in contact with misrepresentation of the Commission's work to speak in correction of error. The general policy that characterized the work of the Commission under Sir Adam's administration still maintains.*

*In order that there may be no misunderstanding with regard to the action taken by the Chief Engineer, Mr. F. A. Gaby, in his Address at Ottawa in 1931, which was the subject of specific criticism in the recent Session of the Ontario Legislature, a formal statement dealing with this matter was issued and appears below.*

*It should be appreciated that the title "Chief Engineer", by no means fully indicates the scope of the duties that Mr. Gaby has for many years discharged. In his capacity as Chief Executive officer of one of the largest electric supply undertakings in the world, he has the responsibilities, and exercises the functions, of a General Manager and has, for many years, in an executive capacity, directed the departmental affairs of the Hydro organization. He appears before the Commission to receive its instructions and to report upon all matters handled by the Commission's large staff. Mr. Gaby is entirely within his rights and is properly discharging his duty when he draws attention to error or misrepresentation inimical to the welfare of the Hydro undertaking. If, for example, anyone publicly states that the Queenston-Chippawa development had cost $150,000,000 when its actual cost, as recorded in the Annual Report of the Commission, is less than $77,000,000,*

*it would be the duty of Mr. Gaby or, indeed, of any responsible officer of the Commission, to call attention to the error and, if possible, to correct it by reference to published Reports or statement of the Commission.*

NOTE—The circumstances which gave rise to Memorandum No. 2 and the recital of which constituted the concluding part of that Memorandum have already been published in the March, 1934, "*Bulletin*", see pages 83 to 87, and this statement therefore is not repeated in this issue.

## MEMORANDUM No. 3

### STATEMENT OF CHAIRMAN EXPLAINING THE PRINCIPLE THAT IS INVOLVED WHEN HYDRO SALARY INFORMATION IS DEMANDED IN THE LEGISLATURE

*IT is a matter of vital importance to the people of Ontario to preserve the status that the Hydro undertaking has always had, of being an independent business enterprise, owned by the co-operating Hydro municipalities. Efforts recently made to have the Hydro-Electric Power Commission treated in the Legislature as though it were a Department of the Provincial Government, would, if successful, have seriously undermined the independence of administration of the municipalities' co-operatively-owned electrical properties.*

*Specifically, individual members of the Provincial Legislature have on more than one occasion asked that information be supplied to the Legislature respecting the salaries paid to the executive heads of the Hydro-Electric Power Commission —a matter which, under the Power Commission Act, comes under the sole jurisdiction of the Commission as the trustee and administrator of the municipalities' electrical undertaking. The Chairman of the Commission has consistently refused to concede that any body other than the Association representing the owners—the municipalities—has a right to this information.*

*Speaking in the Legislature on March 29th, 1934, the Chairman took special pains to explain the principle that was governing the Commission in the position it had taken. One of the leading daily papers of the Province said that the Hydro Chairman's statement was one*

> *"which affects a principle undoubtedly to become a keen Provincial issue and which is likely to be a basis of assault by Hydro critics . . . "*

*If, as is thus intimated, this important principle is to be one for further "assault", then it is believed that the citizens of the Hydro municipalities, in the interests of retaining the administration of their Hydro investment of nearly $400,000,000 as an independent business enterprise, ought to take full cognizance of the real principles at stake in this matter, as set forth in the recent representations made to the Legislature.*

*The statement made in the Legislature by the Chairman of the Commission, on the 29th of March, 1934, is as follows:*

## Statement by Hon. J. R. Cooke
## Chairman, Hydro-Electric Power Commission

IN dealing with the subject of salaries paid the Commissioners and executive heads of the Hydro-Electric Power Commission, I trust the members of the Legislature will accord due consideration to my representation that a principle is involved which would be violated were the Commission to yield to the requests that have been made respecting salary details. I can assure you that there is no arbitrary desire to withhold information that is within the right of any member of this House to request. In very few words, I desire to explain the position the Hydro-Electric Power Commission takes in this matter.

The Commission is not a Government department, but has been constituted the administrator of an independent business undertaking owned by the co-operating Hydro municipalities. As trustee, the Commission has sole power to make its own appointments of officers and to determine their salaries. It should be remembered that the Commission's staffs are composed largely of persons trained in highly specialized fields of activity. The public utility field makes exceptional demands. Our employees have not only directed their talents and energies to carrying on the work of this Hydro undertaking, but they have made it their life occupation.

The status of the Commission being what it is, the Commission would not be fulfilling its duty as trustee for municipalities if it were to give to individuals—even though they may be members of the Legislative Assembly—information such as it is appropriate to disclose only to the owners of the Hydro undertaking. The members of this Legislature do not regard the details of operation of municipal enterprises, such as water works, street railways, and other similar undertakings, as proper subject matter for questions in this House. Members do not enquire regarding salaries paid by even the local municipal electrical distributing utilities, and yet the Commission's undertaking is virtually a part of these local undertakings conducted *co-operatively* by a trustee for the owner municipalities.

A year ago when the subject of Hydro salaries was raised and through political effort kept prominently before the public mind, with the implication that the salaries were unjustifiably high, and misstatements were being made respecting the amounts of the salaries, the Commission, in order to clear the public mind in the matter, published through the body representing the co-operative municipal electric utilities the salaries of the Commission and of the executive staff. Having regard to the magnitude of the undertaking —one of the very largest in the world—it is believed that the salaries are not only reasonable, but substantially lower than those in most—if not all—organizations of a comparable magnitude carrying on public utility business under private ownership.

The Commission took even this course somewhat reluctantly. As a matter of general policy the Commission regards it as undesirable to make a practice of publishing the salaries of the staff. In this it is merely carrying out what is universally recognized by those in charge of other large business undertakings, to be prudent business policy. It was felt, however, that there was no other way to correct the misrepresentation that was being disseminated.

The efficiency of the whole Hydro organization depends upon the maintenance of confidence, and this confidence includes confidence in judgment, in fair treatment, in insurance against undue disturbance and, of course, in the payment of remuneration adequate to leave the employee unharassed by curtailments or fears arising in respect of his employment.

In view of the action taken by the Commission having the salaries published through a proper organization, the information has been widely available through the public press so that it can no longer be simply knowledge of the facts that is sought, because this knowledge is available. One wonders, therefore, why this question is repeated on the Order Paper? Can it be that the object is to implant in the public mind the doctrine that the appointment of Hydro officials and their salaries is not under the jurisdiction of the Commission, but of the Government? This doctrine is absolutely out of harmony with any proper conception of the rights and functions of the Hydro-Electric Power Commission and of the municipalities for which it acts. To yield to the demand that has been made would be to violate the basic principle underlying the Commission's administration, and for this reason I must respectfully decline to submit the salary information requested respecting the executive heads of the Commission's staff. There is no objection to giving data relating to the Commissioners themselves whose salaries are determined by the Lieutenant-Governor-in-Council. These have previously been submitted to this House and to the municipalities, but for convenience I here repeat them for the present year as follows: Chairman, $13,175.04; Vice-Chairman, $7,975.08; Commissioner, $7,975.08

I may add that last year, in order definitely to correct the misrepresentation being made about the salaries of executive heads, I gave instruction that, for this year, these salaries would be recorded in the Municipal Section of the forthcoming Annual Report.

# MEMORANDUM No. 4

## Financial Reserves of Ontario's "Hydro" Undertaking

*LAST month, in a statement submitted to those associated with the work of the Hydro utilities, attention was drawn to the necessity for presenting, in readily accessible form, various statements and explanations that would be serviceable in showing the entirely groundless nature of various misrepresentations and innuendos that were being circulated respecting the work of the Hydro-Electric Power Commission of Ontario.*

*Three Memoranda have been issued.*

*No. 1 cleared away misunderstanding that may have existed respecting the purchase of the Madawaska properties, the purchase of the Dominion Power and Transmission properties and the purchase of power by the Commission from the Beauharnois interests.*

*No. 2 showed that, under the Commission's policy, members of the staff were encouraged as they came into contact with misrepresentations of the Commission's work to speak in correction of error, and reference was made to the particular instance where the Chief Engineer of the Commission had, in 1931, corrected the erroneous statement that the cost of the Queenston-Chippawa development had been $150,000,000, whereas in point of fact it was less than $77,000,000.*

*No. 3 made clear that the principle of independence of administration of the 'Hydro' undertaking was at stake when demands were made by certain members of the Legislature, seeking to have the Commission in connection with salaries of its staff treated as though it were a Government department.*

*And now, No. 4 deals with a class of statement which represents that when the Commission draws upon certain reserves set up for a specific purpose it incurs a "loss". The entirely unjustifiable character of this conception will be clearly evident from the statement which follows:*

## Financial Reserves of Ontario's "Hydro" Undertaking

PARTICULARLY in recent years various statements have been made that misrepresent the purpose and status of the financial reserves that have been set up in connection with the $400,000,000 undertaking administered by the Hydro-Electric Power Commission of Ontario, and by the local Hydro utilities of the 760 municipalities for which the Commission acts as trustee. These reserves at the end of 1933 aggregated approximately $129,000,000. The financial interest that each Hydro consumer has in his co-operative undertaking is of sufficient magnitude to merit his special attention.

Ontario's Hydro undertaking is operated in the sole interests of the electrical consumers who now number about 600,000, and the total investment is made on their behalf. The average investment for each consumer, therefore, is more than $650, and the reserves already set up for various purposes represent rather more than $200 for each Hydro consumer. Obviously, it is important that the citizens be fully and correctly informed regarding the nature and purposes of these reserves in order that they may be able to recognize and discount any inaccurate statements that may be made publicly, or that may be reported in the Press.

**The Purpose of the Various Funds Included in Total Reserves**

The reserves of the Hydro undertaking, aggregating $129,000,000, include the reserves laid aside in connection with both the properties administered and operated directly by the Hydro-Electric Power Commission as trustee for the co-operating municipalities, and the properties owned and operated individually by the various municipal electrical utilities. Each of these classes of reserves is divided into separate funds in accordance with the natures of the current and future disbursements they are designed to meet.

The various individual reserves have features in common, namely, that they are funds *into* which money is put; *in* which it is retained for a considerable period, generally earning a revenue; and *from* which the money is taken out when the time comes that the required disbursement is to be made.

Speaking more particularly with respect to the purposes for which the Commission's reserves are set up, it may be said that money is put into reserve *for renewals* so that it can be taken out when equipment wears out and new equipment has to be bought to replace the old. Money is put into reserve *for obsolescence* so that when improved equipment that can reduce the cost of power is invented, it can be bought by taking money out of the reserve. Money is put into reserve *for contingencies* so that when injuries due to accidents, storms or like physical causes occur, or when serious economic disturbances affecting power costs take place, the injuries can be made good and the power costs stabilized by taking money out of the reserve. Money is put into reserve *for sinking fund* so that at the end of forty years it can be

taken out to pay off in full the capital liability that was incurred at the beginning of the period, and thus progressively free the plant from interest costs.

Similarly, with the reserves of the individual Municipal Utilities; the *depreciation* reserve provides funds that can be taken out for renewals of worn-out distribution plant or for replacement of obsolete plant. The *sinking fund and debentures paid* represent money used, or to be used, for paying off the capital liabilities of the utility. Even the utilities' *surplus*, under *The Power Commission Act*, must be and is used for the benefit of electrical consumers.

It will be appreciated, therefore, that the reserve policy of Ontario's "Hydro" undertaking, under which there has up to the present been accumulated a total of $129,000,000, is simply a necessary policy of making provision, while properties are earning a revenue, for definite disbursements that must occur at various times, due to the unavoidable events of operation, such as wear and tear, and scientific progress, or to the statutory requirements for retirement of debt.

**Withdrawals from Reserves not Evidence of Loss**

In other words, the carrying out of the reserve policy constitutes, essentially, the payment, through the provision of instalments in advance, of future expenditures; such instalments while awaiting the time for disbursements, being placed in 'reserve'.

Now, the properties of the Hydro-Electric Power Commission and of the municipalities have been expanding very rapidly, and consequently most of the equipment is still comparatively new. Because of this, payments *out of* the reserves are at the present time, and for some years will continue to be, much less than the payments *into* the reserves. For the same reason, the amount of money *in* the reserves is rapidly increasing. This circumstance has caused some—thoughtlessly no doubt—to lose sight of the fact that the sole object of putting money into the reserves in the first place, is to be able to take the money out of the reserves when the times for necessary disbursements arrive.

It might be thought that no informed person, understanding the nature and purpose of a reserve fund, would fall into the error of assuming that recent withdrawals from certain of the Commission's reserves are to be interpreted as 'losses'. Yet some have publicly misrepresented such utilization of reserve funds as evidence of 'losses'. An additional fact—which might be taken to cast grave doubt upon the sincerity of those making the unfounded allegations of 'losses' by the Commission—is that everyone knows the Commission is simply an agent and trustee, providing power for the municipalities *at cost*, and the Commission, by the same token, cannot

possibly have either 'profit' or 'loss'. Its costs and revenues simply balance each other.

**Stabilization Fund**

The circumstances out of which these unfounded allegations of 'loss' chiefly arise, are in connection with the Commission's Reserve for Obsolescence and Contingencies. On certain of the Commission's systems special provision has been made for a special anticipated contingency, which provision may be referred to as the 'stabilization' portion of this reserve.

It is known that general business and industrial activity fluctuates in an unpredictable way, whereas the Commission, on account of the time occupied in construction of power plants or otherwise arranging for power supplies, must make its arrangements years in advance of power demands. If the amount of power used drops suddenly because of industrial depression making factories idle, there is no way by which costs of hydro-electric power can be made to drop correspondingly, unless, indeed, money has been laid aside in the good years, so as to become available in the poor years.

Realizing this, the Commission, as soon as the Queenston-Chippawa plant had reached a favourable earning position, began to build up a fund for the specific purpose of equalizing the costs per horsepower in poor years of business with those of good years, and from 1926 to 1930 it accumulated in the fund for stabilization purposes more than $10,000,000. In 1932 and 1933, which, everyone will admit, were years of severe depression, the Commission judged the time to have arrived for which it had previously and designedly made provision, and accordingly it applied a portion of the money in the stabilization fund to the purpose for which it had been provided. The result is that part of the costs in the unfavourable period of 1932 and 1933 were provided for in advance during the favourable period of 1926 to 1930 and the money in the interval was kept in the reserve.

There is no more basis for misrepresenting this action of the Commission as has been done, than there would be, for example, for saying that the Commission is operating at a loss when it pays for renewing an electrical generator out of the reserve for renewals. When the generator was in operation it provided revenues, from which its special reserve provision was made for its own renewal; and correspondingly, when general business was in normal activity, the Commission's undertaking made an advance reserve provision for possible recession in general business, which actually occurred in severe form in the years 1932 and 1933 and in consequence of which, this particular 'reserve' was drawn upon.

It should be fully appreciated that in 1926, when the Commission found it could establish an addition to the contingency fund for stabilization purposes, it had no more fore-knowledge than others regarding the time or the

severity of any possible period of economic depression that might be in store for the world.

Ontario's Hydro enterprise did not entirely escape the effects of the world depression when it came, but few undertakings, it is believed, passed through this period with less inconvenience to their customers. In securing these advantages the stabilization fund has played a prominent part. Thus, instead of the Commission being found fault with and being misrepresented as having incurred an alleged loss, it should be commended for having provided a special contingency fund from which a very advantageous stabilization of power costs was accomplished, and an extra burden thereby kept off the electrical consumers at a time when they were ill-equipped to bear it.

**Total Reserves Continue to Increase**

Special reference has here been made to the reserve for stabilization. It is important to remember, however, that this reserve is only a part of one of the several reserves of the Commission. The lessening of the amount in the contingency fund due to the substantial draft upon it for stabilization during the years of continued depression has prevented the total reserves from increasing as much as they otherwise would have done, but notwithstanding this fact, the reserves as a whole—due to the continued setting aside of full sinking fund and renewal provisions—have increased. Assuredly this is an impressive tribute to the soundness of the financial basis upon which the whole Hydro undertaking is administered. The total reserves at the end of 1929 aggregated $90,000,000, and at the end of 1933, notwithstanding withdrawals for stabilization, they had *increased* to the sum of $129,000,000. The *increase* in the reserves of the individual municipal utilities in this period has been $15,750,000, and the *increase* in the Commission's reserves, in connection with the extensive properties it administers, has been $23,500,000. Even in the most severe year of all, 1933, the reserves of the Commission increased in the aggregate more than $3,000,000.

If the citizens served by the Hydro undertaking bear in mind the essential facts regarding the financial status of properties administered on their behalf, such as have just been outlined, they will not allow unfounded assertions, alleging 'losses' or unsound administration of their assets and of the reserves protecting them, to pass current without the intelligent challenge and correction of Hydro consumers who desire to protect their property and its good name.

# Bibliography of Lightning Protection for Distribution Circuits

**Compiled by R. E. Jones, Assistant Engineer, Distribution Section, Electrical Engineering Dept., H.E.P.C. of Ont.**

*Proceedings N.E.L.A. 1911 P. 1074.*

THIS is a report of the Committee on Lightning Protection.

An arrester does not protect apparatus more than 400 or 500 feet away. Mild discharges perhaps can be taken care of by a spacing of 1000 feet. Experience shows the loss of arresters themselves to be inversely proportional to the spacing as a general thing. At a cost of $6.00 installed an arrester could be economically used for each $500.00 of transformers.

C. P. Steinmetz remarked that 10 years previously electric circuits were practically helpless against lightning and protective equipment available was largely based on imagination. He suggested the abandoning of the protection of the lines in favor of protecting the apparatus. Lightning rarely damages the line.

* * * *

*Proceedings N.E.L.A. 1912 P. 243*

In Chicago different arresters have been placed on each phase of the primary circuit to obtain data.

* * * *

*Handbook on Overhead Line Construction. N.E.L.A. 1914.*

Lightning phenomena are discussed somewhat in detail.

The multigap arrester operates on the theory that the voltage distribution across a series of gaps is not equal but that it is concentrated on the gaps nearest the line. When the arc starts it spreads over the row of gaps and with the voltage then evenly distributed, the total gap is too great and the arc dies out at the end of the first half cycle. The gaps are made of an alloy of high and low melting point metals. The former preserves the shape of the electrode while the latter tends to cool the arc.

This arrester has been improved by the addition of high resistance rods shunted across some of the gaps.

The Compression Type Arrester has a series of gaps preceded by a rod of comparatively low resistance. The lower part of the column of gaps is surrounded by a grounded antenna.

The Circuit Breaker Type Arrester has a resistance rod with gaps at both ends and the lower gaps shunted by a simple electro magnetic circuit breaker. Power follow-up current passes through the coil and contacts of the breaker rather than across the gaps. The breaker is operated by this current and opens, breaking the arc inside a tube.

* * * *

*The Effect of Transient Voltages on Dielectrics. F. W. Peek, Jr., General Electric Co. A.I.E.E. Sept. 1915.*

This is a general discussion of the effect of speed of a voltage wave in breaking down insulation and various types of gaps.

* * * *

*Studies in Lightning Protection on 4 kv. Circuits I. D. W. Roper, Commonwealth Edison Co. A.I.E.E. 1916.*

The investigation was carried on for 5 years, starting in 1911, with about 16,000 transformers in use in 1915.

In 80 per cent. of cases of blown fuses signs of arcing were found, mostly between terminals on board or between terminals and cover, with fewer cases of arcing around bushing inside or outside the case.

Grounding of cases has little effect on protection of transformers.

In 1914 it was decided to remove the terminal boards of all transformers brought into the shop.

There is a definite ratio between transformers burnt out and fuses blown from lightning.

In 1914 the minimum size fuse was set at 25 amperes with no fuses on transformers over 40 kw.

In 1913 when changes were made in transformers an arrester was placed on each pole where transformer was 15 kw. or larger. In 1914 this was changed to 7.5 kw. In 1916 this was changed to include all transformers.

It was estimated that improvements in service were caused, 30 per cent. by removal of terminal boards, 20 per cent. by increasing ratio of arresters to transformers, and 50 per cent. by moving arrester from adjacent pole to transformer pole.

Three types of arrester were used, each in its own area.

A single arrester may not have the capacity to discharge a heavy stroke.

Lightning is "spotty" in an area.

Arresters at transformers only appear inadequate when they are separated above 2000 feet.

A protective device should be less subject to trouble than the apparatus it protects.

For conditions in Chicago the cost of arresters is not warranted by the saving in cost of repairs. It is, however, justified when the improvement in quality of service is considered.

* * * *

*The Oxide Film Lightning Arrester. C. Field. A.I.E.E. June, 1918.*

This paper covers a similar field to the one by C. P. Steinmetz.

*Lightning Arrester Spark Gaps. C. T. Allcutt. A.I.E.E. June, 1918.*

This paper discusses the dielectric spark lag with impulse voltages.

*The Oxide Film Lightning Arrester. C. P. Steinmetz, General Electric Co. A.I.E.E. June, 1918.*

Lightning protection to date is reviewed.

The Oxide Film arrester is described.

Two metal plates as electrodes are kept apart by a porcelain ring. The space between is filled with an active material, lead peroxide, applied under moderate pressure.

The lead peroxide is a good conductor but has the characteristic that by the action of an electric discharge it is converted in the path of the discharge into a lower oxide, which is an insulator. Thus when alternating current is passed through the cell it gradually converts the active material around the electrode into an insulating film. This grows in thickness until it cuts off the flow of current at 250 to 300 volts per cell. An over-voltage punctures the film and allows the discharge and in so doing forms another film.

* * * *

*Studies in Lightning Protection on 4 kv. Circuits II. D. W. Roper, Commonwealth Edison Co. A.I.E.E. 1920.*

Records were kept and manufacturers were advised from time to time of results.

One manufacturer made a tabulation of the relative values of arresters but this laboratory report did not agree with the experience in Chicago which latter placed the arresters in quite a different order.

In 1919 the investigation was continued with the manufacturers in co-operation whereby the results were tabled.

The Chicago system is 4 wire star with 2080 volts to neutral. The primary neutral is grounded at the station only. At transformers 1–2400 volt and 1–300 volt arresters are used, the latter on the neutral. With 3 phase banks the centre point of the transformer is not tied to the line neutral.

In 1918, 7.5 kv-a. transformers predominated in number. Ground electrodes were 10 feet of ½ in. galvanized pipe driven at base of transformer pole. The secondary ground was similar but at an adjacent pole. The secondary was also grounded to the water pipe at services. At this time there were 20,000 transformers in service.

Eight different arresters were considered. They were designated each by a letter and a diagram was made.

The following were found to affect arrester performance:—

1. System of distribution and grounding of neutral.
2. Primary terminal boards.
3. Shielding effect of buildings or wires of other companies.
4. Resistance of arrester ground connections.
5. Make of transformer.
6. Size of transformer.
7. Age and previous service record of transformer.
8. Variation in the distribution and intensity of the lightning.
9. Density of arresters, that is, number per square mile.
10. Design of the arrester.

A history was kept of each transformer burnt out. The city was laid out in checkerboard plan for this purpose.

1/400 of 1 per cent. of poles shattered by lightning. This is much lower than the experience in open country.

Of 529 transformers burnt out by lightning note was made of surrounding conditions of 97 of them and not one was found with the primary wires adjacent to the transformer overshadowed by tall trees or buildings.

Grounds on transformers burnt out not much different from other grounds. Of 2770 grounds tested in 1916, 70 per cent. were about 10 ohms, with others up to 140 ohms.

Density of arresters up to 150 per square mile.

Earlier arresters were in wooden cases so that they could be periodically inspected. Annual inspection and repairs were expensive.

Gaps in an arrester should be between parallel plates, discs or rings and not cylinders or spheres so as to permit heavy repeated discharges without altering the length of the gaps.

In event of failure the arrester should shatter or give other visual evidence. An arrester should have

no moving parts and should not be capable of repair without removal from the pole.

Field service showed several arresters to be of equal protective value but laboratory tests showed appreciable differences.

Transformer troubles can be reduced by removal of terminal boards, installation of arresters, use of larger primary bushings. An arrester on the transformer pole is more effective than one on the adjacent pole. Where the density is less than 50 transformers per square mile, the use of additional arrester on line pole will probably be justified.

An arrester with a series of gaps with some shunted by high and low resistances has better protective value than one with a resistance in series with the gaps.

In the discussion, C. P. Steinmetz stated that lightning conditions on a distribution system were different from those on a transmission line due to network of circuits and low insulation. The voltages induced on a distribution line by a lightning discharge are far higher than the transformer insulation can withstand for any appreciable time. It thus becomes a race between the time lag of the transformer insulation and the rate at which the arrester can discharge the excess voltage. Hence the effect of density of arresters. The reason the removal of terminal boards and use of larger bushings improves service is that the air between the board or lead and the case has not the high time lag of solid insulation or oil and flashover occurs. With 100,000 volts impressed on a 2,300 volt arrester the shape and number of gaps usually found in an arrester can have little effect on action of arrester. An arrester one span away from a transformer differs in protective value by time taken for charge to travel the distance to transformer which is about 1/10 millionth part of a second for 100 feet.

*National Electrical Safety Code Discussion. Oct. 1920.*

Sec. 9—97 (b) Separate artificial ground is required for arresters on account of the dangerous potentials which may be set up between ground wire and ground during a discharge, due to ground resistance.

*National Electrical Safety Code. Third Edition. Oct. 1920.*

Sec. 9—97 (b) Lightning arrester ground connections shall not be made to the same artificial ground (driven pipes or buried plates) as circuits or equipment, but should be well spaced and, where practicable, at least 20 feet from other artificial grounds.

* * * *

*On Deviation from Standard Practice in Lightning Arresters. E. E. F. Creighton. A.I.E.E. Feb., 1922.*

This is a review of the subject as regards higher voltage system protection.

* * * *

*1922 Developments in Autovalve Lightning Arrester. A. L. Atherton, Westinghouse Elec. & Mfg. Co. A.I.E.E. Feb., 1923.*

An explanation is given of the valve effect of a glow discharge in arrester operation.

The valve consists of a pile of electrodes separated by thin mica rings of 5 mils thickness with a critical voltage of about 350 per gap. The elec-

trodes are of resistance material. The speed of this valve is high. It is designed to operate at 25 per cent. overvoltage. The capacity for discharge depends on the area of the electrodes.

For commercial reasons a line of arresters has been developed with reduced discharged capacity. This is offset by the frequency of installation.

This arrester was developed by Dr. Slepian.

In the discussion, D. W. Roper stated that this arrester was showing up well in the Chicago investigation.

*Lightning Disturbances on Distribution Circuits. M. MacLaren. A.I.E.E. April, 1923.*

An investigation was made on the system of Philadelphia Electric Company.

On secondary circuits there are a few meters burnt out but records are hard to obtain if service is not interrupted. Most damage is on secondary runs of over 1000 feet. A gap in the service installation is suggested. If meter insulation were improved there might be damage elsewhere on the premises.

In centre of city there were no lightning failures with transformers not protected by arresters.

In other parts of the city there were fewer transformer troubles on circuits protected by arresters. Ground resistance at arresters was high where transformers were damaged. Fuse blowing was reduced by use of arresters. Fuses are 1 ampere per kv-a. with a minimum of 5 amperes.

In discussion, K. B. McEachron agreed there was need of secondary protection. The telephone companies have come to it. There is little value in designing an arrester of low resistance if the ground resistance is high.

*Pellet Type of Oxide Film Arrester. N. A. Lougee, General Electric Company. A.I.E.E. June, 1923.*

This is a description of the Pellet type arrester. It operates on the same principle as the Oxide Film arrester.

Lead peroxide pellets are shaken up with an insulating powder (litharge) and are thus given an insulating coating.

The pellets are placed in a porcelain cylinder with metal electrodes at each end and a gap in series.

The insulating film on each pellet acts as a porous spacer and insulator. This eliminates the objectionable time lag of a solid insulation.

When new the leakage current is less than 1 milliampere and it does not increase with service. The pellets are self-sealing. They are about 1/8 inch in diameter.

In the discussion, K. B. McEacheron stated that with a heavy discharge current the voltage across the arrester is considerably lower than with any other arrester he knew of.

* * * *

*Proceedings N.E.L.A. Overhead Systems Committee. 1924. P. 125.*

Arresters should be on the same pole as equipment to be protected.

Arresters will reduce fuse blowing and give limited protection to equipment.

*Electric Thunderstorm Field Researches. Dr. H. Norinder, Sweden, Elec. World. Feb. 2, 1924.*

The problem of lightning protection

was investigated starting with the determination of the field gradient near the earth's surface.

A short line was set up and a special cathode-ray oscillograph was developed.

The conclusion was that a spill-over of an insulator or a spark gap may cause a secondary charge with steep wave front. For this reason it was recommended that the best protection was strong line insulation and reliable interturn and intercoil insulation in the transformers instead of horngaps and arresters.

*Thunderstorm Researches Versus No Lightning Arresters. E. E. F. Creighton, General Elec. Co., Elec. World, March 15, 1924.*

This is a series of comments of the paper by Dr. Norinder in *Elec. World* of Feb. 2, 1924.

While we all would like to have apparatus so designed that arresters would be unnecessary, it is an economic question and the use of arresters may be likened to fire insurance.

Dr. Norinder's investigation does not appear to be extensive enough to justify his conclusions.

*Lightning Arrester Application from the Economic Viewpoint. A. L. Atherton. Westinghouse Elec. & Mfg. Co. A.I.E.E. April, 1924.*

It is known that injury to insulation by surge voltages begins at some overvoltage such as 2.5 to 3 times line voltage and increases probably faster than the increase in voltage.

Heavy surges of 1000 amperes are infrequent, 100 amperes probably being common.

The l.v. (line) arrester gives half as good protection as the s.v. (station type).

The economic value of arresters is worked out on this basis.

In the discussion, K. B. McEachron did not agree that any type of arrester yet developed would give 100 per cent. protection.

*Tests on 22 kv. and 4 kv. Lightning Arresters. W. F. Young, Duquesne Power Co. A.I.E.E., April, 1924.*

Various 4 kv. arresters were tested with surge voltages of 40 and 60 kv.

1. Carbon Pile Arrester—single column of discs, enclosed gap.—Rapid speed and high discharge capacity. Interrupted dynamic current satisfactorily.

2. Multiple gap with two shunting resistance rods.—High speed of discharge, intermediate discharge rate, and interrupted dynamic current.

3. Oxide Film, sphere gap. Intermediate speed of discharge, fair capacity of discharge, and interrupted dynamic current.

4. Multigap-series resistance. Low speed and discharge capacity but interrupted dynamic current.

5. Series water resistance and sphere gap.—Low speed and discharge capacity. Test was not completed.

6. Porcelain bushing over iron pipe.—Horn gaps between line and ground. High discharge rate but did not interrupt dynamic current.

7. Multigap with series resistance and circuit breaker to increase gap. Intermediate discharge capacity but would not interrupt dynamic current.

8. Multigap with series resistance in porcelain. Intermediate speed and

capacity of discharge. The test was not completed.

In the discussion, Messrs. Creighton and McEachron pointed out that with the few tests made, they served only to separate the sheep from the goats and could not separate further.

*Bennett Lightning Arresters Catalogue of Electric Power Equipment Corporation. April, 1924.*

Description of a type of lightning arrester using a carbon electrode immersed in water.

For temperatures below 25 degrees the tank is lagged and an electrothermal heating unit is used.

*Lightning Arrester Grounds. H. M. Towne, Gen. Elec. Co. Publication of G. E. Co. July 7, 1924.*

Various types of grounds and the effect of local conditions are discussed.

Methods of measuring ground resistance are described.

Driven grounds should be located in damp locations as much as possible.

A driven pipe need only be of sufficient diameter to permit driving. A 1 inch pipe is recommended. Driven pipes should reach permanent moisture but should never be less than 6 feet in length.

Station grounds should be 5 ohms or lower and low voltage line arrester grounds should not exceed 15 ohms.

Ground resistance may be lowered by the use of multiple pipes or by treatment of the soil.

Ground wire down the pole should not be smaller than No. 6 B. & S.

The ground wire from the arrester should be as short and as straight as possible. It should be kept separate from the secondary ground except in the case of the common neutral system.

* * * *

*Lightning and High Voltage Phenomena. F. W. Peek, Jr. Publication of Gen. Elec. Co. 1925.*

The origin of lightning discharges and effects of strokes are described in detail.

The effect of lightning on a transmission line is discussed.

*Wisconsin State Electrical Code. Jan. 1925.*

Lightning arrester ground connections shall not be made to the same artificial ground (driven pipes or buried plates) as circuits or equipment, but should be well spaced and where practicable, at least 20 feet from other artificial grounds.

*Lightning Protection of Distribution Systems. A. L. Atherton, Westinghouse Elec. & Mfg. Co. Elec. Journal, June, 1925.*

A short history of lightning arrester progress finishing with a description of the Autovalve arrester.

* * * *

*Theory of the Autovalve Arrester. J. Slepian, Westinghouse Elec. & Mfg. Co. A.I.E.E. Feb. 1926.*

While this paper has reference to higher voltage protection, it includes a detailed study of the theory of the operation of the Autovalve arrester.

*National Electrical Safety Code. Dec. 1926.*

Sec. 9—97 (b). Lightning arrester ground connections shall not be made to the same artificial ground (driven pipes or buried plates) as circuits or

equipment, but should be well spaced and where practicable, at least 20 feet from other artificial grounds.

* * * *

*Protection from Lightning. F. W. Peek, Jr., General Electric Co. Electrical World, Aug. 20, 27, 1927.*

An investigation was made to determine the characteristics of lightning. Lightning was studied in the field and then attempts were made in the laboratory to produce similar effects. A 2,000,000 volt, 10,000 ampere, impulse generator was used for these tests.

The voltage of lightning discharge from a cloud to the ground appears to be about 100,000,000. Lightning is generally non-oscillatory. The duration is often a few micro-seconds but may be longer. The current is of the order of 80,000 amperes.

A ground wire is more effective if it is well grounded. It should be either of a non-magnetic material or with its outer layer non-magnetic.

When a lightning charge is released on a line it travels in both directions at about 1000 feet per micro-second.

There is a protected area around a lightning rod with a radius equal to about four times the height of the rod.

With needle gaps on impulse voltage of a certain value the voltage necessary to jump a gap was 2.25 times that required by a 60 cycle voltage.

With sphere gaps the voltage required to jump the gap is not affected by the wave shape.

Lightning flashover of insulators is the same whether the insulators are dry or wet.

Both oil and solid insulation have time lag and the lightning strength may be several times the 60 cycle strength.

The protection of transmission lines from lightning is discussed.

* * * *

*The Lineman's Handbook. E. Kurtz. 1928.*

The Oxide Film, Autovalve, Compression Type, Multigap, and Circuit Breaker Type Arresters are described briefly.

*Impulse Characteristics of Driven Grounds. H. M. Towne, General Elec. Co. G. E. Review. Nov. 1928.*

Many materials of a non-homogeneous character do not follow Ohm's law but decrease in resistance as the current density increases. As soil is non-homogeneous this might account for the difference between the effective resistance of a ground and that indicated by a measuring instrument.

Laboratory tests were made using ½ inch galvanized iron pipes driven into gravelly soil. Various lengths of pipe and multiples were used in the tests. An impulse current with an output of several hundred amperes supplied charges for these tests.

The resistance of ground at maximum voltage of discharge was from 34 to 80 per cent. of the measured 60 cycle values.

Tests were made with one class of soil only. Results do not justify the assumption that high resistance soil will allow satisfactory operation of arresters.

* * * *

*Ferranti Surge Absorber. E. T. Norris, Ferranti Ltd. Electrical World, Jan. 26, 1929.*

*Reprint of Ferranti Ltd.*

The protection of lines and other

equipment from the effects of voltage surges is reviewed briefly.

A good protective device should operate effectively when required and should not interfere at all with normal power frequency operation.

The danger to the winding of a transformer depends not on the amplitude of the surge but on the steepness of the wave front. Damage may be caused by a surge of relatively low crest value but with a steep wave-front.

The damages caused by surges are cumulative and may not be evident for years.

The amplitude of a surge causes flashover of insulators while the steepness of its wave front causes the breakdown of transformer windings. An ideal surge arrester should be brought into action both by the amplitude of the surge and the steepness of its wave front, particularly the latter.

Arresters are divided into two classes—the Discharge type and the Absorption type. In general the former is operated by the amplitude of the surge and the latter by the steepness of the wave-front.

A Discharge type of arrester has a valve action, consisting of a valve element to prevent a flow of power current and a gap in series. An arrester must be so designed that it will not discharge on normal operation of the line. The gap must therefore be so set that it will not operate with less than excessive overvoltage, a steep wave-front having no effect on it. The operation of a discharge arrester is affected by the point on the power wave at which the surge occurs. Thus if a positive surge occurs on a negative power wave the arrester will not operate with an excessive voltage.

Discharge arresters are most suitable for prevention of flashover of insulators since they are operated by the amplitude of the surge.

The Absorption type of arrester is connected in series with the line and the transformer or other apparatus. There is no ground connection in the ordinary sense to permit power current to follow to ground.

The Ferranti Surge Absorber is of the absorption type and consists of an air core inductance in series with the line. Adjacent to the conductors of the coil but insulated therefrom is a sheet of conducting material. This sheet is called the dissipator and is connected to ground. The loss in the absorber at 50 cycles is negligible. The coil may be helical in shape with a cylindrical dissipator or it may be a flat spiral with flat dissipators.

The coil of the absorber acts as the primary winding of a transformer and the dissipator as the secondary with one short circuited turn. The losses due to the secondary current induced in the dissipator by the surge together with stray eddy current losses are responsible for between 10 and 30 per cent. of the effectiveness of the absorber.

As steep wave-front surges have a very high frequency, they set up heavy eddy current losses in the dissipator. This accounts for about 40 per cent. of the action of the absorber.

As the absorber has a high electrostatic capacity between coil and dissipator it acts as a high frequency filter.

Thus the absorber reduces the amplitude of the wave somewhat by ab-

sorption as well as reducing the steepness of the wave-front.

Tests showed that a Ferranti-Surge Absorber averaged a reduction of 85 per cent. in the voltage across the end turns of a transformer.

An electrolytic arrester has an absorption percentage of 10 per cent. while some of the more modern types of discharge arrester have values as high as 30 per cent.

Tests were made with a surge generator using both a Cathode-ray Oscillograph and a Klydonograph.

*High Voltage Phenomena in Thunderstorms. Marcel A. Nissman, Western Precipitation Co. A.I.E.E. Jan., 1929*

This paper covers the theory of lightning phenomena as derived from laboratory experience compared to conditions in the atmosphere on a much larger scale. While the voltage present in a thunderstorm may be 100,000,000 volts, the time of duration is extremely short.

*Lightning. F. W. Peek, Jr. A.I.E.E. April, 1929.*

Lightning may now be said to be at last on an engineering basis since it is expressed numerically in volts and amperes. It has been removed from the realm of the "medicine man".

The following progress has been made:—

The wave-shape of lightning has been pictured by the cathode-ray oscillograph.

The time required for a cloud to discharge has been measured with the same instrument.

The attenuation of lightning waves on a transmission line has been determined.

Natural lightning waves have been reproduced in the laboratory where their effect on equipment has been studied at will.

A lightning generator producing over 3,600,000 volts has been constructed.

A review is made of the lightning tests possible to make with laboratory equipment and the results obtained from such investigations.

Following is a summary of the characteristics of lightning.

Voltage—order of 100,000,000.
Current—order of 100,000 amperes.
Energy —order of 4 kw-hr.
Power —order of thousand billion h.p.
Time —order of a few micro-seconds.
Gradient at breakdown — 100 kv./ft.

Time for cloud discharge from one to ten micro-seconds.

Discharge generally non-oscillatory.

Total energy dissipated in world by lightning 1,200,000 kw. continuously (very approximate).

*Lightning on Lines*

High voltage waves of few micro-seconds front and effective duration of 1 to 20 micro-seconds.

Low voltage waves of much greater duration.

Voltage either by induction or by direct strokes.

Breakdown voltages higher than 60 cycle.

*Laboratory*

Voltages higher than ever observed on lines have been obtained and tests on apparatus made.

*The Lightning Problem in Power Transmission and Distribution. H. M. Towne, General Elec. Co. A.M.E.U. Convention, Bigwin Inn. June, 1929.*

A review of the lightning problem from the formation of the lightning charge in the cloud to its effect on power lines.

References are made to several papers on the subject.

Curves are given showing the various characteristics of arresters under different conditions.

*Travelling Waves Due to Lightning. L. V. Bewley, General Elec. Co. A.I.E.E. July, 1929.*

This is a mathematical discussion of the cause and effect of a travelling wave induced in a transmission line by a lightning discharge.

(*To be continued.*)

## This Is Not a Fish Story

The following is from a trouble report by the Superintendent of Iroquois Rural Power District. It tells its own story.

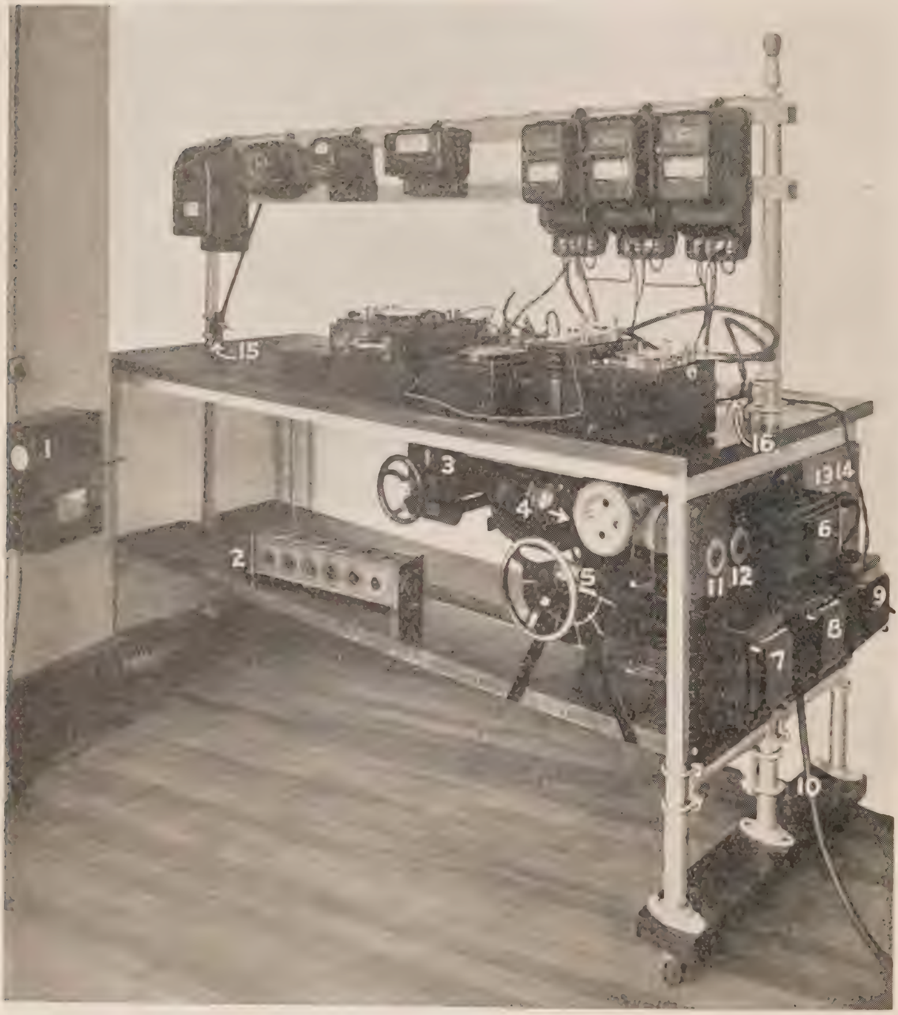
For several days prior to May 13th the voltage on the Iroquois system was below normal. The operator at the Beach Generating Station advised us that he was having trouble with the exciter which is of the vertical type direct connected to a small water turbine. For some unknown reason the exciter was running below normal speed with the gates wide open.

The operator, "Pat" Beach, asked for an interruption on Sunday afternoon for the purpose of examining the wheel. This was arranged, and the water was shut off from the wheel pit and the turbine examined. It was found that an oversized eel had worked its way into the turbine and got jammed between the revolving and the stationary parts of the turbine where besides the friction it created, it was shutting off some of the working surface of the wheel.

The odor around the pit when "Pat" removed the eel was not of John DeKuyper gin nor of attar of roses perfume and we were prepared to believe "Pat" when he said that the eel was dead.

# Demand Meter Testing Equipment

By W. R. Catton, Manager, Brantford Hydro-Electric System




*Demand Meter Testing Bench. 1—3 wire 110/220 volt receptacle, heavy duty. 2—Portable potential block (not shown in place). 3—Carbon pile current regulation. 4—Voltage regulator. 5—Tap changer. 6—Double throw switch, 220/110 controlled voltage. 7—Transformer switch. 8—Main switch. 9—550 volt switch. 10—Plug and cable. 11-12-13-14—Receptacles for different voltages to potential block. 15-16—Current.*

THE characteristics of a popular type of demand meter are such that the time required for test is rather long; therefore, it would appear to be good practice when building testing equipment to provide capacity for a large number of meters. We built the meter bench (as shown in the picture) in 1931 to accommodate at least 20 demand meters. As the equipment is used periodically, we made it portable and when not in use is placed against the wall out of the way.

The bench is constructed of 1¼ in. pipe, angle iron, and hard maple, detail of which is very clear in the picture.

The equipment consists of the following:

1. 3 wire, 110/220 volt receptacle, heavy duty,
2. Portable potential block,
3. Carbon pile current regulation,
4. Voltage regulator,
5. Tap changer,
6. Double throw switch, 220/110 controlled voltage,
7. Transformer switch,
8. Main switch,
9. 550 volt switch,
10. Plug and cable,

11-12-13-14. Receptacles for different voltages to potential block.

15-16. Current.

The bakelite panel is 18 in. by 29 in. which accomodates all of the enclosed switches and receptacles.

We used the core of a 7½ kw. transformer, took off a damaged primary winding and replaced it with a heavy square wire secondary with 3, 7½, 15, and 25 volt taps.

The voltage regulator is made from a ¼ h.p. repulsion induction motor by replacing the winding on the armature; very fine voltage adjustment is secured by using a worm drive (as used in an ironing machine) connected to the rotor shaft.

No. 15 and 16 connects to carbon pile through tap changer; these studs are equipped with wing nuts, and we find this scheme extremely handy for meter connections.

The portable potential block has 6 receptacles on three sides, wired separately, also receptacle on ends; the block can be energized for use on three voltages, if desired, or can be made to handle one voltage only.

The voltage regulator will buck or boost 30 per cent., and is so arranged that 550 volt potential transformer can be energized through the regulator.

Types of meters that can be tested, 20 to 24—Type E D., 25 to 100 ampere, 4 L and R. H., also, dial run on 24 domestic type meters over 50 ampere capacity.

# Rat Rapids Development—Albany River

BOTH the electrical and mining industries are greatly interested in the fact that the Hydro-Electric Power Commission of Ontario has been authorized by the provincial government to proceed with the installation of a hydro-electric development on the Albany River, for the supply of approximately 1,000 horsepower to the mines in the Pickle-Crow mining area, some 20 miles north of the power site. The plant is to be located on the northerly outlet of the Albany River from Lake St. Joseph, known as the Rat Rapids channel. There will also be a control dam across the southerly outlet, or Cedars channel of the river.

Plans have been prepared for a plant that will develop from 1,000 to 1,200 horsepower under heads ranging from 13½ to 15 feet. The scheme of development consists of the installation of a four-runner, 164 r.p.m. turbine, located in an open concrete flume and driving a horizontal 6,600-volt, 3-phase, 60-cycle generator, which will be located in a generating room adjoining the turbine chamber at the down-stream end. The dams, of which there will be a total length of over 700 feet, will be of the rock-filled timber crib type, rendered watertight by sheeting on the upstream face, and incorporating sluiceway capacity sufficient to handle the maximum anticipated flood flows from the lake.

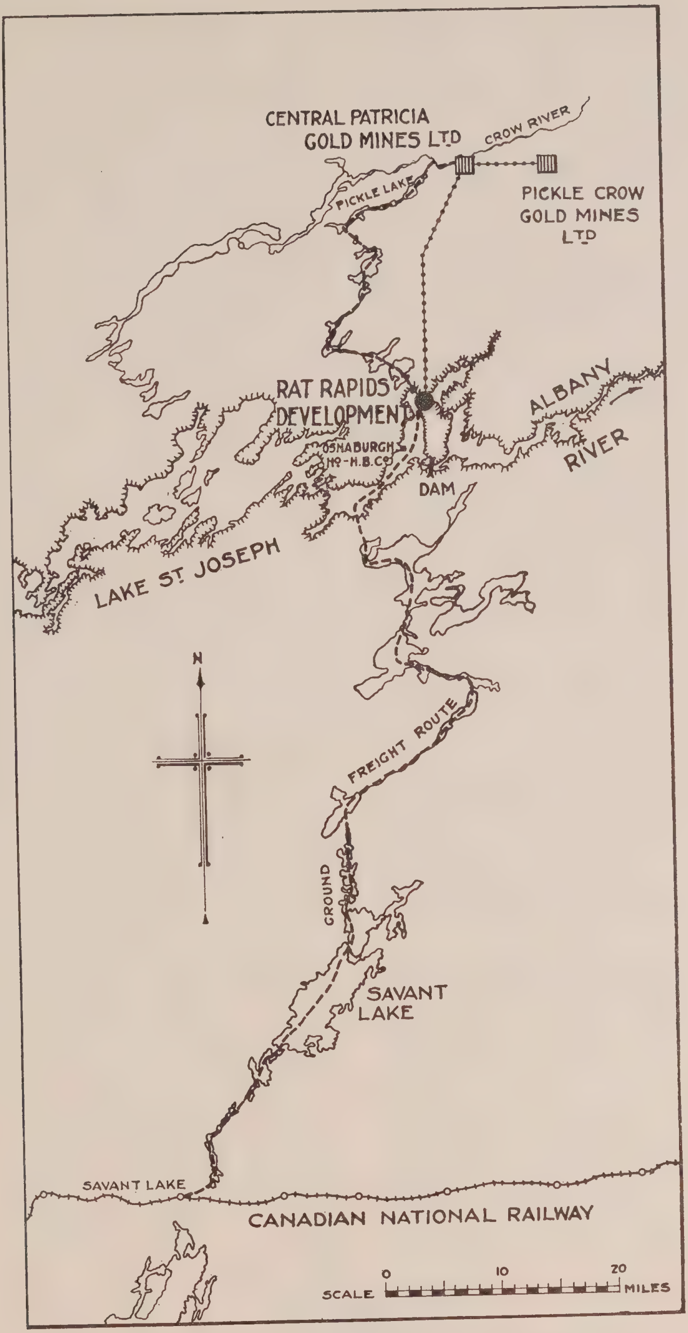
### 20-Mile Transmission Line

Power will be stepped up from 6,600-volt to 22,000-volt in an outdoor transformer station, from whence it will be transmitted over a wood pole transmission line extending northerly to the mines, a distance of approximately 20 miles north of the site.

The turbine, governor and generator for this development are being obtained from storage at one of the Commission's older plants, with the exception of the turbine runners, which will have to be purchased new to obtain a type suitable for operation under the low head conditions which will exist at this plant. The fact that this equipment was for the most part already available, proved to be a decided asset, in that advantages were taken of the winter transportation facilities for transporting at least a part of this equipment over the ice to the site.

One of the most difficult problems to be faced in the carrying out of this work is that of transportation from rail head at Savant Lake on the Canadian National transcontinental railway to the power site, a distance of 84 miles by winter road. The Northern Transportation Company is already organized in this district for the handling of equipment into the mines, a distance of some 125 miles north of Savant Lake, and arrangements have been made with this company for the handling of the Commission's supplies and equipment needed for the carrying out of the work.

The stimulus given the gold-mining industry by the steadily advancing price for gold during the past three




*Map showing location of Rat Rapids Development.*

years has resulted in a decided growth of the mining industry, not only in the older mining areas, but also in such new fields as the Pickle-Crow and Red Lake districts.

—*Electrical News and Engineering*

## Lord Hale Puts Ferrymen in Their Place

"What is a public utility? Let me take you back three hundred years to King James of England. The reign of this King is remembered for many great events, two of them in particular: he gave us a great translation of the Bible and the inception of a great public policy. It was in the days when Shakespeare was writing that a public outcry arose in England from travellers who sought to cross the deeper streams by means of ferryboats.

"Obviously these ferries, which were needed to connect the highway on one side with the highway on the other, were limited to specific points. They were, therefore, monopolistic in their nature.

"The ferryboat operators, because of their privileged position had the chance to charge whatever the traffic would bear, and bad service and high rates had the effect of forcing much trade and travel into long detours or to the dangers of attempting to ford the streams. The greed and avarice of some of these ferryboat owners remained a public issue for many years until, in the days of Lord Hale, a statement of public policy was set forth by the great Chief Justice.

"The law lord said that the ferrymen's business was quite different from other businesses, that the ferry business was, in fact, vested with a public character, that to charge excessive rates was to set up obstacles to public use, and that the rendering of good service was a necessary and public responsibility.

"'Each ferry,' said Lord Hale, 'ought to be under a public regulation, to wit, that it give attendance at due time, a boat in due order and take but reasonable toll.'

"In those simple words, Lord Hale laid down a standard which, in theory at least, has been the definition of common law with respect to the authority of government over public utilities from that day to this.

"With the advance of civilization, many other necessities of a monopolistic character have been added to the list of public utilities—such necessities as railroads, street railways, pipelines and the distribution of gas and electricity. This principle was accepted, firmly established, and became a basic part of our theory of government."

The foregoing is an extract from President Franklin D. Roosevelt's book "Looking Forward" . . .

—*Winnipeg Hydro News*.

# Let's See*

YOU are reading this page within arm's length because it is practicable and convenient to do so. The ideal distance for your eyes would be fifteen feet, or even more. Then, the unnatural strain of converging the eyes, making them bow-legged so to speak, would no longer exist. Your eyes would be back to normal—to those primitive days when severe visual tasks did not exist. Of course, magazines and books ten or twenty feet square, with type to match, are impracticable. But the convenience of holding a magazine in your hands is just one of the many examples of compromise which followed civilized progress as it moved indoors.

And there are many others. How many women have pitied the day laborer as they watched him swinging his pick under the broiling sun? Plenty! And yet every woman who does fine needlework or sewing upon dark material for prolonged periods is going to be more fatigued, measured in terms of nervous muscular tension, than the begrimed male she pities. Being ABLE to see, to sew or read is only a minor aspect of seeing. EASE of seeing is the important thing. The average person does not discriminate between the two because he is unaware of the constant drain of energy caused by seeing. No other single human activity consumes so much.

That is why the wives of tired business men should not regard the phrase in the terms of a musical comedy myth. A man may sit in a soft, comfortable leather chair, an electric fan may add to his bodily comfort, a buzzer may summon a secretary, the telephone is within easy reach, but if this T.B.M. is subjecting his eyes to severe visual tasks, most likely under poor lighting conditions, there is ample evidence to support his assertion that he feels tired, has a headache, or lacks appetite.

### And the Children of These T.B.M.

You have read pages of a magazine without being conscious of the act of seeing unless the conditions for seeing were very poor. Doubtless, you have never asked yourself, "What does it cost me to see?" More important still are the questions: How much has it cost my child already? And how much will be the continued toll due to my negligence and the general lack of consciousness and knowledge of seeing? You know that it costs something in gasoline and wear-and-tear for an automobile to do its work. You know that an electrical appliance wears out more quickly if abused by overloading and negligence. You know that muscular energy is expended when you work in the flower-garden or elsewhere, and that you expend nervous energy in sewing. Driving an automobile tires you because you use up energy through muscles and the nervous system. Under poor conditions of seeing, such as rain or fog, you tire very rapidly. If you analyze why, even casually, you conclude that fatigue in the latter case is due largely to poor seeing. But seeing, being such a quiescent

* From a "Better Light, Better Sight" pamphlet by the General Electric Company, Nela Park, Cleveland, O.

activity and having become so automatic even in infancy, is not generally considered to involve expenditure of human energy and wear-and-tear.

The costs of seeing to human seeing-machines may be divided roughly into three classes—eye-defects, bodily disorders, and drain of energy through muscular strain and nervous tension. Some of these costs can be eliminated entirely and the others greatly reduced by attention to the factors which can be controlled. Of these, lighting is always necessary and always controllable.

### PREVENTABLE EYE-DEFECTS

The cost in eye-defectiveness due to poor seeing conditions is the most obvious item of human expenses in seeing. But eye-defects are generally ignored, except to counteract them with eye-glasses, a kindly service which eye-specialists are rendering to hundreds of thousands. But can anyone seriously conclude that eye-defects are necessary, particularly in young people? Do we not have enough faith in Nature to believe that eyes should develop normally, as legs and arms do, through proper use? If we do not, statistics should be convincing.

Suppose we could temporarily convert the defects of eyes into defects of legs. What a heart-rending spectacle would be witnessed on any city street. Every other person would limp perceptibly. Many would pass by on crutches and some in wheel-chairs. Such a parade should convince anyone that much of the spectacle was due to neglect and ignorance.

### NEARSIGHTEDNESS

Nearsightedness is rare in infancy. But as children reach school age it begins to increase, and from class to class the percentage of nearsightedness increases. Many receive, or should receive, a pair of glasses as a graduation present—and their thanks should be addressed to Negligence. The cause of preventable nearsightedness was mentioned in the very first paragraph. Reading or performing other visual tasks within arm's reach, for long periods, is unnatural. If the conditions for seeing are poor — and they universally are — the child often unconsciously makes up for this deficiency by holding the book too close to his eyes. Type has been developed for the so-called normal distance of reading, which is commonly considered to be about fourteen inches. But this is a normal distance only from the viewpoint of convenience and comfort of arms, not of eyes.

Poor lighting aggravates nearsightedness. The size of type, as far as the eyes are concerned, depends upon the distance from the eyes. At twenty-eight inches the letters on a printed page are only half as large, visually, as they are at fourteen inches. At a distance of seven inches they are four times as large as at twenty-eight inches and twice as large as they are at fourteen inches. Under inadequate light, which is so prevalent indoors, the tendency is to compensate somewhat by holding the printed page closer to the eyes. A bad habit is in the making. Nearsightedness may develop. It becomes progressive through continued poor seeing conditions. A remedy is to improve the lighting and, whenever possible, to increase the size of type

and to make objects more visible by various other means. Adults should refuse to read small print for long periods, and children should not be permitted to read it at all.

### In Homes Where There Are Old People

Many who read this page have reached the so-called bifocal age. Eyes become more and more far-sighted with the years. Apparently, the eyes cannot focus accurately upon objects as close to them as they used to. The power of accommodation has decreased and usually continues to decrease with the years. It is commonly considered that this defect is just a result of growing old; that is, the eye-lens loses its resiliency.

It is not uncommon to see old persons, without glasses, holding an object at the full length of the arm in order to focus their eyes upon it. A newspaper at this distance appears as though the type were only half as large as it is at fourteen inches. Obviously glasses are needed by a person who cannot read a newspaper within arm's length. The efficacy of the glasses is obvious. Still, adequate light is also effective. For example, a newspaper held at arm's length can be read as easily at a window in the daytime as it can be read at fourteen inches under the usual meager intensities of artificial illumination at night.

In the general neglect of lighting and other factors which contribute toward better seeing, the additional requirements of old eyes are not taken into account. The pupil of the eye is the doorway of light. Everyone knows that the apperture or shutter of a camera controls the brightness of the image on the film. As eyes grow older, the pupil becomes smaller for any given condition. On this basis alone, old persons need at least twice as much light on a printed page as young and middle-aged persons do. Considering also that their eyes have become dulled by years of use and abuse, old persons require several times as much light as young people.

### What Poor Seeing Does to You

The effects of poor seeing are so obscure and indirect that they are not ordinarily traceable to the cause. Eye-defects are the most obvious costs of poor seeing, but even these seem remote from the cause. Headaches are commonly due to poor lighting and prolonged close visual work. These are unnatural conditions which produce the unnatural effect of headache. Eyes become fatigued and the results are often visible. Dizziness, nervousness and even indigestion commonly result from poor seeing. Often much of the cause is eliminated by correcting the eyes with glasses. However, throughout the world, seeing conditions are poor and, superposed upon this state of affairs, is the strain of converging the eyes for long periods upon close work.

### Nervous Tension

Perhaps you recall how you perspired when making your first speech, or when under some other unusual situation. When driving an automobile over country highways in the daytime you are probably in a state of relaxation. But as traffic is entered, a degree of nervous muscular tension becomes apparent. At night on a well-lighted boulevard the ten-

sion may be of low degree, but turn into a dark or poorly lighted street and note how the steering wheel is gripped more tightly and the tension generally increases. Drive in a fog or rain for an hour and then note with what relief you reach your destination. Nervous muscular tension is fatiguing because energy is being expended. A boxer tires from being on his toes mentally, muscularly and neurally. So it is with teachers and mothers on particularly trying days. All this shows that nervous muscular tension drains human energy.

Extensive research into the problem of SEEING resulted in the important discovery that even easy tasks relating to seeing produce a definitely measurable nervous muscular tension. Reading a book was chosen as the task. The book was of excellent dull-finished paper and the type was satisfactorily large, being about twice the size of that commonly used in the body of the front page of newspapers. The reader sat comfortably in a chair and read leisurely with the tips of two fingers of the left hand resting normally upon a large flat button. The excuse for this was that the button was to be pressed down at the completion of reading each page. Actually, unknown to the reader, the pressure unconsciously applied by the fingertips was continuously recorded for the entire period of reading. Many persons were tested many times under various conditions of seeing throughout an entire year.

This task of reading was about as easy as reading can be. It was extremely less difficult as a visual task than sewing, darning and many common tasks in the home and elsewhere. Still, under the best conditions tested, some nervous muscular tension was definitely apparent and measurable. As the conditions of seeing became poorer, the nervous muscular tension greatly increased. For example, when the pages were illuminated to an intensity representing average conditions at night in the home, the nervous muscular tension was much greater than when the intensity was equivalent to that near a window in the daytime. It is seen that this test measured ease of seeing, or at least measured an effect which diminishes as ease of seeing increases.

Other conditions of seeing were also studied in this manner. Glaring light sources, still too common in the home, were found to produce tension at the fingertips as severe as those experienced under low levels of illumination. As a result of all this work, it can be definitely stated that nervous muscular tension is always a result of seeing, whether we are conscious of it or not. But more important still, is the proof that it increases with the severity of the visual task and that it can be greatly diminished by improving the seeing conditions. Of course, if the eyes need correcting glasses, these should be obtained. Certainly the eyes as tools should be "sharpened" to do their best. But even for normal or properly corrected eyes, the conditions for seeing are generally very poor. Various factors are involved but, as is shown later, light is grossly inadequate in our indoor world. Light is an essential partner of eyes in the performance of seeing, and it has the advantage of being controllable.

WHAT TO DO ABOUT IT

Every housewife is familiar with the common measuring sticks of the things with which she has to do—except the tremendously important task of adequate seeing. A bushel of potatoes. A quart of milk. A pound of sugar. Sixty-eight to seventy degrees of heat. Now here is a simple way to understand how light is measured. Think of a candle stuck in the neck of a bottle. Think of the amount of light that candle gives at a distance of one foot . . . put the two words together. Foot-candle.

With this measure in hand, let us consider the wide differences which exist between light sources. Outside on a clear day in midsummer the light is equal to 10,000 of these foot-candles. On an overcast day this intensity may drop to 1,000 foot-candles. On the sunny days that you spend on the front porch reading and sewing you still enjoy the light of 500 of these foot-candles. Now let us see what happens when we move indoors. First, if we sit by the window, in the daytime, the light will vary from 100 foot-candles up to several hundred, depending on what sort of day it is outside. But now night comes and we turn on the lights. What happens? Suppose we first turn on a bridge lamp with a 60-watt lamp in it. About a foot from the lamp we find we have 80 foot-candles; at two feet, 20 foot-candles; and at three feet away the light is only about 9 foot-candles. And if you are reading five feet away from this lamp you are getting only the equivalent of three candles, stuck in a bottle top! It is easy to see, therefore, how important a factor distance from light source really is. Think of this the next time you see your child reading a book while he lies on the floor!

If we replace the 60-watt lamp with a 100-watt lamp, we have 150 foot-candles at a distance of one foot and the equivalent of 100 candles at a convenient reading distance. The advantage of this added light is obvious. However, distance is again the most important factor because ten feet away the light is about the same as reading by one candle at a distance of one foot!

*Contrast* is the most important factor in seeing. This is high in the case of reading because the contrast between the print and the page is fixed by the printer. It is very low in the case of sewing and especially so when the material is dark. It requires, as far as your eyes are concerned, literally hundreds of times more light to make sewing a task even comparable in ease with the task of reading a newspaper. But even all reading is not alike. This page, because of the type size and quality of paper, is easier to read than your newspaper. And it requires three times as much light to read a telephone directory as it does to read the same print in a well printed book.

*Brightness* is another important factor. This is particularly so indoors at night, because the level of brightness is generally less than a thousandth of that outdoors during most of the day. Just because you are getting enough light from a 100-watt lamp as you read does not mean that your eyes do not pay any attention to the level of illumination elsewhere in the room. They do. If your surroundings are dark, a con-

siderable decrease in seeing arises. This does not mean that the room must be ablaze with light but it does mean that it should not be too dark. The reason for this is that eyes are constantly directed to surrounding areas for relaxation of muscles and mind. Eyes do not need rest from the brightness of the page, as is commonly supposed. If the surroundings are dark, the eyes must re-adapt themselves by altering the pupil size and by changes in the retina. These changes are annoying. Sometimes they are more than that. The important thing to remember is, that while lighting is really a very simple matter, seeing is a very complex one.

What to do about it?

First, there is a rule for the most important members of your family—the children. Watch them as they read. If they are holding their books abnormally close, change their light immediately. Never let them read real fine print.

Second, if you have old people in your home, remember that they need more light than you do. Equip their easy chairs accordingly.

Third, provide plenty of light for reading in bed.

Fourth, don't forget that sewing is harder work than reading. Sewing light is adequate for reading but the reverse is far from true.

Fifth, don't have your surroundings too dark.

Sixth, remember that even light is no substitute for the services of an eye-specialist.

Two things are probably responsible for the low levels of illumination in most homes. One is the widespread belief that intensities of illumination can be too high. The fact is that no visual task indoors will probably ever be over-lighted. This flat assertion can be better understood when it is realized that the average general illumination in the American home is about 2 or 3 foot-candles as compared with outdoor, daytime intensities up to 10,000 foot-candles.

And then there is the question of cost. Perhaps this question can be answered by telling the story of a woman who had two tables of bridge one evening. Both the living room and library were well lighted for the occasion. The first thing the woman did, after the last guest had gone, was to go about turning off the lights. The haste of her action amused her husband. He asked her why she did it.

"I hate to think of all the money these lamps are wasting," she confessed.

Being a man with a taste for facts, the husband took out his pencil and made some interesting calculations. Two packages of cigarettes for each table cost 60 cents. The men smoked 5 cigars at 15 cents for a cost of 75 cents. Four packs of cards for the occasion cost one dollar. The light supper served after the game cost \$3.75. The total for the evening amounted to \$6.10. Then this man figured the cost of the current consumed during the entire evening. It amounted to exactly 8½ cents. Less than the cost of one package of cigarettes!

Obviously, "Let's See" isn't a matter of cost!

# Watthour Meters

**By J. Murray Muir, Editor, Electrical Digest.**

FROM the viewpoint of wide use, few electrical instruments are more important than the watthour meter, or as it is sometimes termed, "the electrical cash register".

On the accuracy of the meter there is dependent, to a very large extent, the proper records and billing of the power that is used throughout the world. Assuming that only about one-half of the three hundred billion kilowatt hours developed all over the world each year, is sold on watthour meter readings at two cents per kilowatt hour, the revenue would be three billion dollars. Some idea of the effect of meter errors may be had from the obvious fact that an error of but a single per cent. represents the sum of thirty million dollars annually!

For a relatively low cost instrument that has to function under so many adverse conditions, such a wide temperature variation and, not infrequently, in damp locations, the substained accuracy of the present-day watthour meter commands respect. Even a ten dollar watch, which approximates the price of a large proportion of meters used, would not be expected to maintain an accuracy of from 98 to 100 per cent. over a period of six years without attention or cleaning.

The development in the design and construction during late years has resulted in the production of an instrument that has lost much of the individuality of the earlier forms, and has made it come to serve more as a means to an end than as an end in itself. Jewelled bearings have been improved and are now universally used. The meters have become more compact, yet without the sacrifice of accessibility of parts. Dust-proof and weather-proof construction has been employed to a fine point; and last but by no means least, temperature and overload compensation has advanced tremendously.

Study of meter requirements in different parts of the world reveals, however, a fairly wide range of accuracy standards. In Great Britain the accuracy limits are plus and minus 2 per cent., similar requirements, it is understood, existing in Australia and New Zealand. In Canada the regulations call for plus and minus 1½ per cent. under normal loading and a maximum of plus and minus 3 per cent. under any load. In the country to our south each State, we find, lays down its own standards. A study of the requirements of a representative group of eighteen States shows one demanding plus and minus 1 per cent.; nine stipulating 2 per cent.; two 3 per cent.; five requiring 4 per cent.; and one 5 per cent.

In Europe the allowable errors run all the way from plus and minus 3½ per cent. to plus and minus 12 per cent., the latter being in Germany under certain conditions of low power factor and low load.

Maintenance of the accuracy of watthour meters shows similar variations in practice. Canada is to be found in the group where, in addition to the initial passing of design and construction, periodic governmental

tests on a fee basis are insisted upon. Here meters must be tested at least every six years, the fee imposed depending upon the size of the meter and running from 60 cents for the smallest, to $5.00 for the largest.

In Great Britain the responsibility of maintaining the required accuracy of the meter is placed on the shoulders of the power companies who, as a general rule, change the meters at shorter intervals than the six years named in Canada. In the United States the requirements are again a matter for each State and the general practice is to name the maximum period between the tests which the companies themselves have to make.

As an example, the test period requirements covering a single phase a.c. meter of capacity not exceeding 25 amperes for a number of States shows the following:

Every 12 months — 1
Every 24 months — 5
Every 30 months — 1
Every 36 months — 10
Every 48 months — 6

Turning to countries further south we find Mexico not only requiring an initial passing of the meter for design and construction but also a periodic Government inspection, under fee, for the maintenance of accuracy. An interesting point, in passing, is that this country can fine the power company $5,000 if a meter is found to be registering "fast". The informer, it is understood, shares in the proceeds.

Generally speaking the basic design of watthour meters does not differ very much the world over. It is true that the prepayment meter has a fairly extensive use in Great Britain as well as in Holland, but this is largely due to custom and habit, growing possibly from the previous use of prepayment gas meters. Prepayment watthour meters are used in very limited numbers in Canada, but chiefly as a means of overcoming collection difficulties which are a product of the unusual economic conditions of to-day. This type of meter is naturally more expensive and complicated than the straight watthour meter and is liable to all the ails and abuses of any coin-collecting machine. It is highly improbable that their use will ever become very extensive in this country. What may be said about Canada can also be said about the United States.

Another departure from the straight watthour meter is that known as the detachable outdoor type and which will be found in use in the United States. As the Canadian code now stands, its use in this country is not permissable. Since the matter is now under consideration more will doubtless be heard concerning it at a later date. Without doubt the accessibility of the outdoor meter is an advantage in sparsely settled and rural districts, where the repeat call for meter reading is a problem. It is interesting to note that in the Argentine it is required that meters be installed in a metal cabinet set in the wall of the building. The outer side of the cabinet is in the form of a window through which the meter can be read from the outside. To protect the window a hinged door is hung on the outside. Some municipalities in Canada have also adopted a similar building ordinance.

Mention was made earlier of two modern improvements in watthour

meter design—temperature and overload compensation. More might be said of these points since they are rather important and of considerable value to the Canadian user.

When a watthour meter is loaded beyond its normal rated capacity, the tendency is for the meter to run slow. This can be attributed to the fact that when the series coil is carrying a heavier current than its normal rating, there is developed in the series magnetic structure a proportionately greater flux. This flux acts on the disc and causes damping similarly to the permanent magnets, the greater the current, the greater the series damping.

There are several ways by which this can be corrected and a typical one is given: Briefly a small magnetic bridge, made up of one or more pieces of steel having the correct magnetic proportions, is placed across the tips of the series yoke and is magnetically insulated from the yoke proper by means of a thin piece of brass. Under normal load the small magnetic bridge carries a percentage of the flux but allows the main flux to pass through the disc. Overloading causes the magnetic bridge to become saturated, allowing proportionately more driving flux to pass through the disc, thus compensating the meter for the tendency to run slow.

Temperature changes have a bearing on meter accuracy since the electrical characteristics of copper wire and the strength of the permanent magnets are affected. The factors governing the change in registration with changes in temperature may be broadly divided into two classes; (1) Those that affect the magnitude of the driving or braking flux, and (2) Those that affect the phase relations between the potential and current fluxes.

Under the first class the permanent magnets contribute, perhaps, the greatest part and with increasing temperature the meter is speeded up. A typical compensation for this is the supporting or mounting of the permanent magnets on studs of a special thermal responsive magnetic alloy whose permeability decreases with increasing temperature. By suitably choosing the characteristics of the mounting studs the permanent magnet damping is changed with temperature by an amount such that the registration of the meter at unity power factor is unaltered by variations over the usual working range.

The inductive load errors or second class, govern the phase relation between the potential and current and are quite negligible at unity power factor but increasingly effective as the power factor is lowered. These errors are chiefly caused by changes in resistance of the potential and lag coils of the meter. As the temperature increases, the resistance of the potential coil increases, with the result that the component of magnetizing current in phase with the applied voltage increases and the potential flux lags the applied voltage by a smaller angle.

In order to compensate the meter for all temperatures it is necessary to introduce some self-compensating means which will automatically increase the compensation in proportion to the temperature increase, or vice versa. One manufacturer, as an example, punches a wedge-shaped slot into the face of the potential magnet.

The upper part of the slot receives the copper lag plate which is then closed by a wedge of thermal responsive magnetic alloy. Induced current in the lag plate sets up a flux in the surrounding metal. Permeability of the steel in the path of the flux is high and does not change with the temperature. The permeability of the section of the path through the wedge, however, does vary and, therefore, the current induced in the lag plate changes with the temperature, so by choosing the proper material for the thermal wedge the ratio is corrected for temperature changes over a wide range.

In conclusion may we again pay our tribute to the watthour meter. Like the quiet, efficient servant that it is, it continues to carry on under all sorts of conditions and with relatively little attention. Where else, in the electrical field, can one get more for his money?—*Published with permission.*

## Aqueducts

The Romans were builders, par excellence, of pipe lines. Beginning about 400 B.C., a truly marvellous aqueduct system was built to supply Rome with fresh water from rivers and springs. When finished, the system comprised 14 lines, from 7 to 59 miles long. The total length was 359 miles, of which 304 miles was below ground and 55 miles above ground on arches. The system could supply Rome with 335 million gallons of water daily. All the ducts were rectangular and varied in cross section from about 2.5 feet high and 5 feet wide to about 6 high and 8 wide. The first ones built were of masonry blocks about 1.5 feet square by 3.5 feet long, laid in cement. To make them watertight, they were plastered on the inside with a mixture of finely-ground pottery and mortar. Later, brick and concrete construction was used. That some of the ducts are still being used is testimony of the skill of the Roman engineers.

—*The Electric Journal.*

# O.M.E.A. *and* A.M.E.U. Convention *at* Ottawa

## June 28, 29 *and* 30, 1934

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

# Study of an Hydraulic Power Site

**By Otto Holden, B.A.Sc., Assistant Hydraulic Engineer, H.E.P.C. of Ont.**

*(From an address to Toronto Section, A.I.E.E., March 23, 1934.)*

ANY development of hydraulic power presupposes a demand for power. The amount of such demand, the nature of the conditions under which it is to be supplied, (whether to a power system or to an isolated customer) and the constancy or load factor, are prime considerations affecting the investigations preceding the development. It is safe to say that to-day the majority of large developments are for supply to large transmission systems, and comparatively few for particular individual loads, either industrial or municipal.

After determination of the demand, the sources available within transmitting distance must be canvassed and investigated. In addition to physical and topographical limitations of any site, there are in some instances legal and other considerations affecting the possibility of development. For example, the Ottawa River being an interprovincial stream with the power rights equally owned by the Provinces of Quebec and Ontario, co-operation of the two provinces is required if full development of a site is to be undertaken. In the case of the Niagara River, the amount of water that may be diverted for power is limited by treaty, and if a development on this river contemplated the use of more than such an amount, a new treaty would be required to be negotiated. In the case of the St. Lawrence also similar international agreement is necessary.

Assuming then that such requirements can be met, and that sites are available either by lease or purchase, investigations must be made to determine the most suitable of these as to capacity, reliability and location. The capacity is of course a function of the flow and the head, and in the case of limited diversions from large rivers the flow is a known factor not requiring further investigation. On rivers where the proposed plant will require the full flow of the stream, careful investigation of the water supply is necessary. With stream flow records available, studies can be made

## CONTENTS

**Vol. XXI** **No. 6**

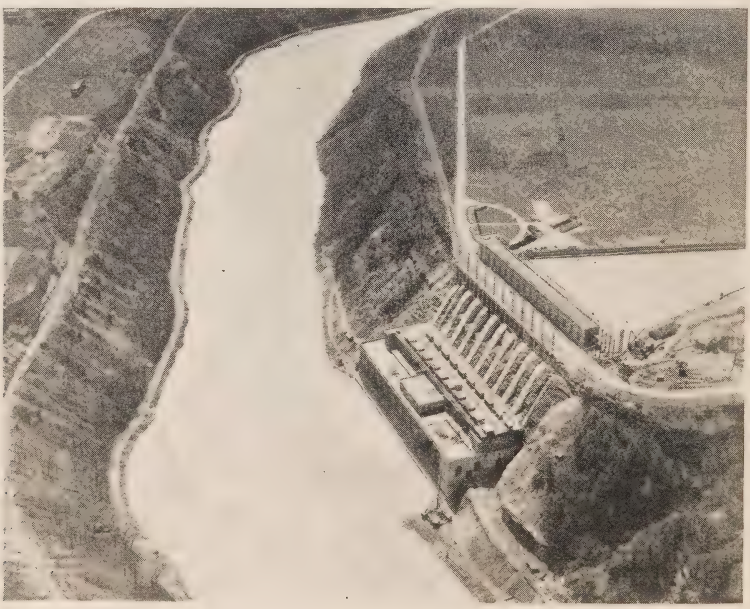
**JUNE, 1934**



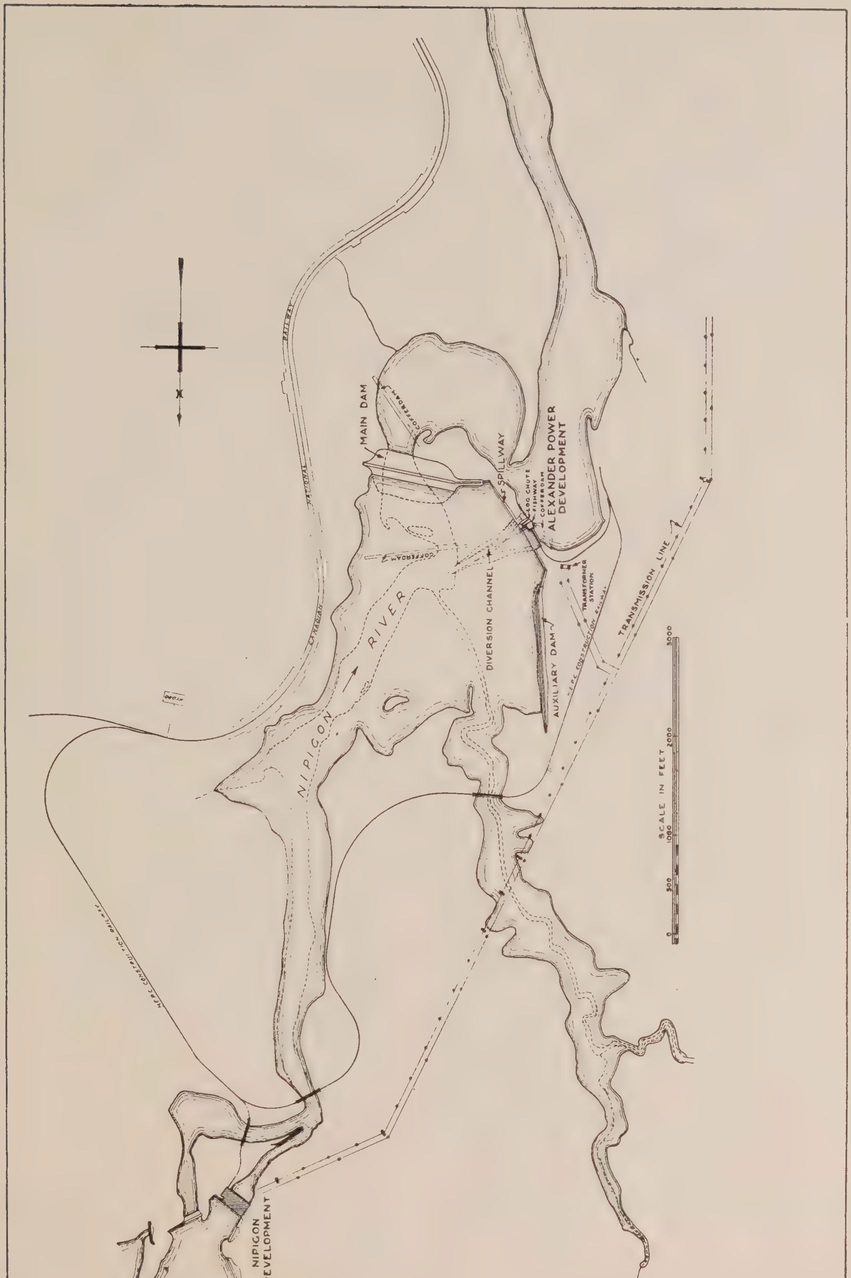
to determine the extent and duration of the flow, and if necessary the possibilities and requirements for storage to maintain the required amount.

In the case of large interconnected systems this study may become very complicated if the various plants are located on different watersheds with varying run-off conditions and amounts of storage already developed. It is necessary to distribute the seasonal demands among the various plants to make the best use of the varying amount of water available at all times, and also to meet any requirements such as fixed levels for navigation or other purpose, as may be imposed on the storage basins.

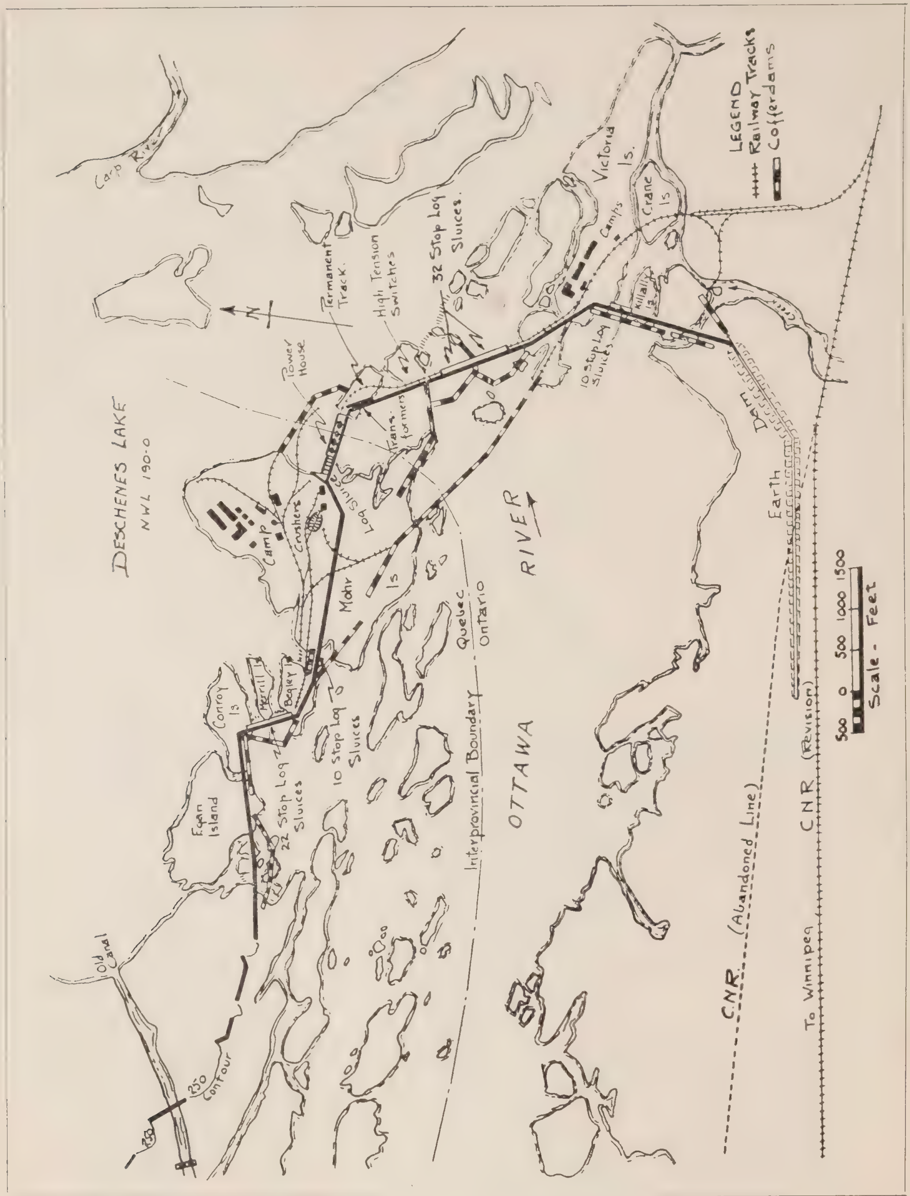
If a favourable site is located on a stream on which no records are available, the flow must be determined from a consideration of the size of the drainage area and comparison of its topographical features with an area on which records are available. This of course is not as satisfactory as working from records, but a reasonable estimate of the flow may be arrived at in this way.



*Queenston Development. Aerial view showing Screen House, Penstocks and Power House. Operating Head, 290-300 feet.*




*General Plan of Alexander Development showing Cameron Falls Power House. Earth Dam built by semi-hydraulic fill method.*




*General Plan of Chat Falls Development. Main Dam and Power House structure 16,500 feet long. Head, 53 ft.*

The head that may be developed is in most instances determined from a study of the topographical features of the proposed development. To this end on an entirely new project, surveys are made which may at first be of a preliminary character only. In this case only the most essential in-

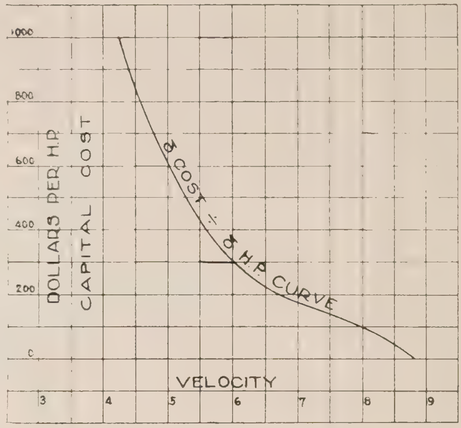
formation need be secured. This would include the water elevations at various points along the river, a cross-section of possible dam sites, and observations as to the geology of the area as indicated by rock outcrops, river banks, etc. It is also necessary at this time that a reconnaissance be made of the area above the proposed dam site to determine that the ground which will form the shores of the head pond will be continuously above the proposed head water level, that is, that the contours will close, or if they do not, what works would be necessary to close them. The amount and nature of the land enclosed in such contours should also be noted as the purchase of such lands often assumes a very appreciable proportion of the cost of a development. The possibility of storage either in natural lake areas or by the creation of storage lakes must also be investigated if the data are not already available. The availability of materials, such as rock and sand for concrete, timber for cribbing, earth suitable for fills, is information which should be secured at this time. The site may offer several alternative schemes of development, all of which should be covered by the investigation, so it will be readily seen that the chief of such a survey party should be possessed of a good imagination and powers of observation.

With such information combined with the data regarding the flow, the capacity of the site may now be arrived at and preliminary estimates of the cost of the development prepared. The possibilities of the available sites having been thus determined, and the cost of the development and transmission and other factors having been compared and duly considered, the one offering greatest advantage is selected for more careful investigation. To this end a detailed survey is placed in hand. This survey will cover the total area included in all feasible schemes for the development of the site. The area in which structures are likely to be located will be closely cross-sectioned, and borings or test pits made to determine accurately the location and nature of the sub-surface materials. Information relative to high water marks as indicating flood conditions will also be secured, and the installation and reading of gauges during such survey will often provide valuable information for use in later design and construction. At this time the contours above and below the proposed headwater level will be run in on the ground, and a plan of the flooded area prepared to permit acquisition of the necessary lands to proceed.

As this information on the site becomes available, more detailed studies of the schemes of development are carried on. Alternative methods of development are investigated more closely. The concentration of the head in one development, or its division into two or more stages may offer possibilities in each case. The changing of the dam or power house location and the substitution of tailrace, canal, tunnels or pipe lines are possibilities that may warrant investigation before the final layout is decided on. The relative costs of these alternative schemes is generally the deciding factor, although in some instances other considerations are of greater weight. When all the feasible general schemes of development have been considered,

and the most advantageous chosen, the final design of the various elements is undertaken.

This includes, among others, the determination of the head water level. This may be fixed by consideration of flooding damage, economical height of dam or some topographic feature. The economic size of canal, tunnel, pipe line or tailrace must also be determined. The type and capacity of the turbine units and the study of the speed regulation of the units for various load changes are items to be settled, as well as the dimensions of the intake and power house structure itself.

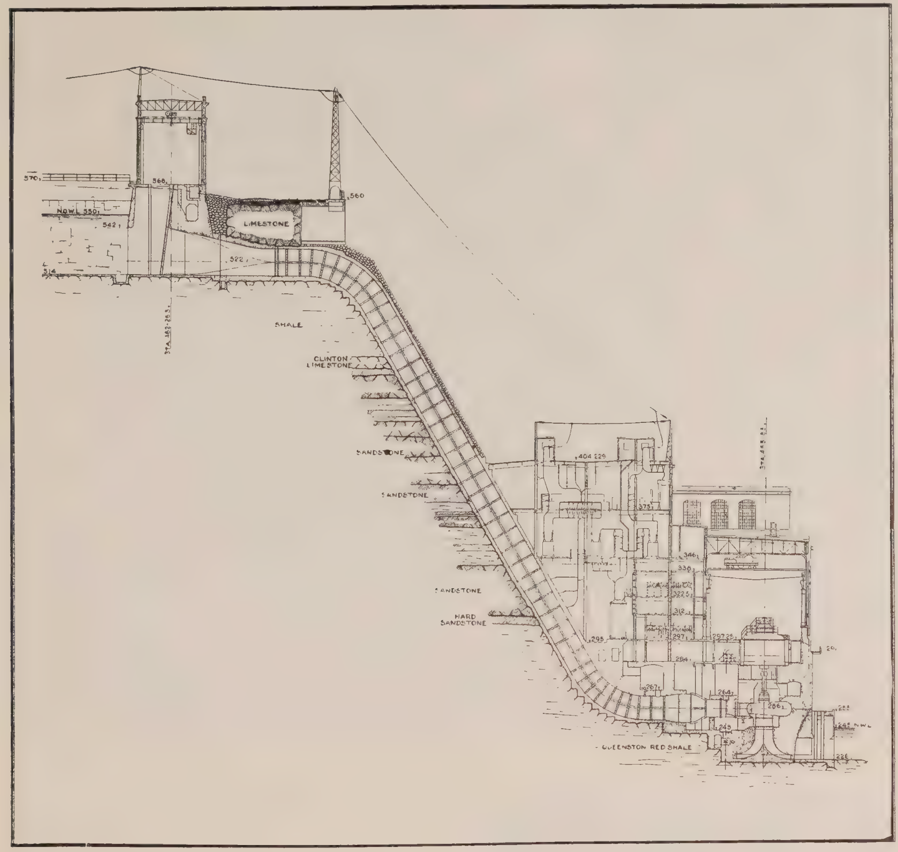



*δ Cost ÷ δ Power Curve. Economic study, of a power canal. Rock section.*

In regard to the fixing of head water level, one feature which in some cases is the determining factor is the presence of rapids upstream from the intake. Broken water so located will in northern latitudes generally give rise to difficulties in winter operation, due to the formation of frazil. The raising of the water level to such a point where these rapids will disappear offers the most satisfactory solution of these difficulties, and one which would warrant considerable expenditure to accomplish. No difficulties in winter operation need be anticipated, if a large head pond with low velocities can be secured.

The fixing of the size of the various water-conveying structures requires a careful economic study. It may be stated generally that, within certain structural or other limitations, the size is arrived at by finding the point at which the cost of a further increment in power resulting from reduced losses is equal to the value of the power so gained. To arrive at this, the cost of conduits of various sizes are calculated, and the power lost in friction calculated for the corresponding sizes. The cost and power lost are then plotted against the size of the conduit. From such plotting, the increase in cost for a small change in size is taken, and the corresponding gain in power. The value of this increase in cost divided by the increment in power at various points is then calculated and plotted, from which latter plotting, known as the $\frac{\delta \text{ Cost}}{\delta \text{ Power}}$ curve, the cost per horsepower of any increment in power can be read, and the economic size determined. In some instances factors other than economic consideration play a large part in fixing the size of these conveying structures. For example, in plants with pipe lines, the matter of pressure rise and speed regulation may be the determining factors in fixing the diameter of the conduits.

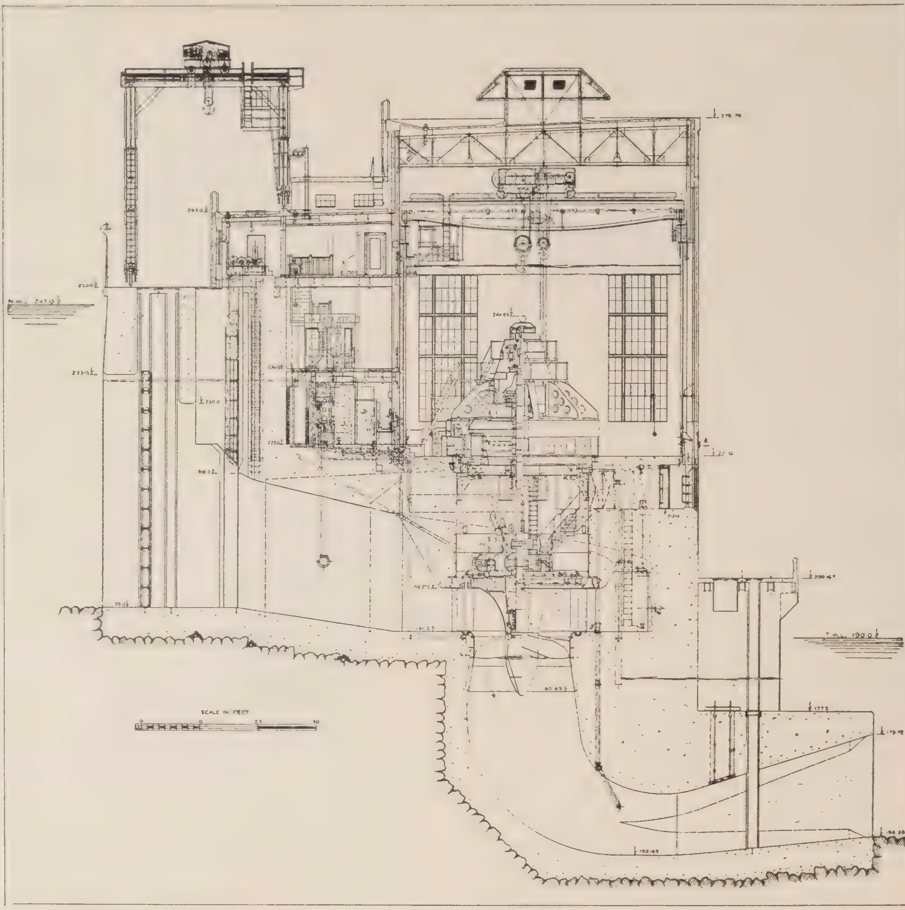
The capacity and type of the turbine units is arrived at as the result of the consideration of several factors.




*Queenston Development. Cross-section Forebay to Tailwater. Power House protected against rise of 55 ft. in lower river.*

It is desirable generally to keep the number of units as few as possible without unduly reducing the flexibility of the plant or exceeding the maximum size dictated by structural limitations.

In the design of hydraulic turbines, there are certain prime standards which have been arrived at by experiment and experience. Departure from these can be made only at the risk of added difficulties in operation and maintenance. A guide to the securing of a satisfactory and reliable unit is summarized in the value of an expression including the capacity, speed and head, in form $\frac{NP^{\frac{1}{2}}}{H^{\frac{5}{4}}}$. This value is known as the specific speed of the turbine runner, and the performance of the unit is dependent on the value of this expression with relation to the head. With the value of this expression fixed within limits and the head a constant, the variables are then capacity and speed. To definitely fix these, it is of course necessary to give consideration to the



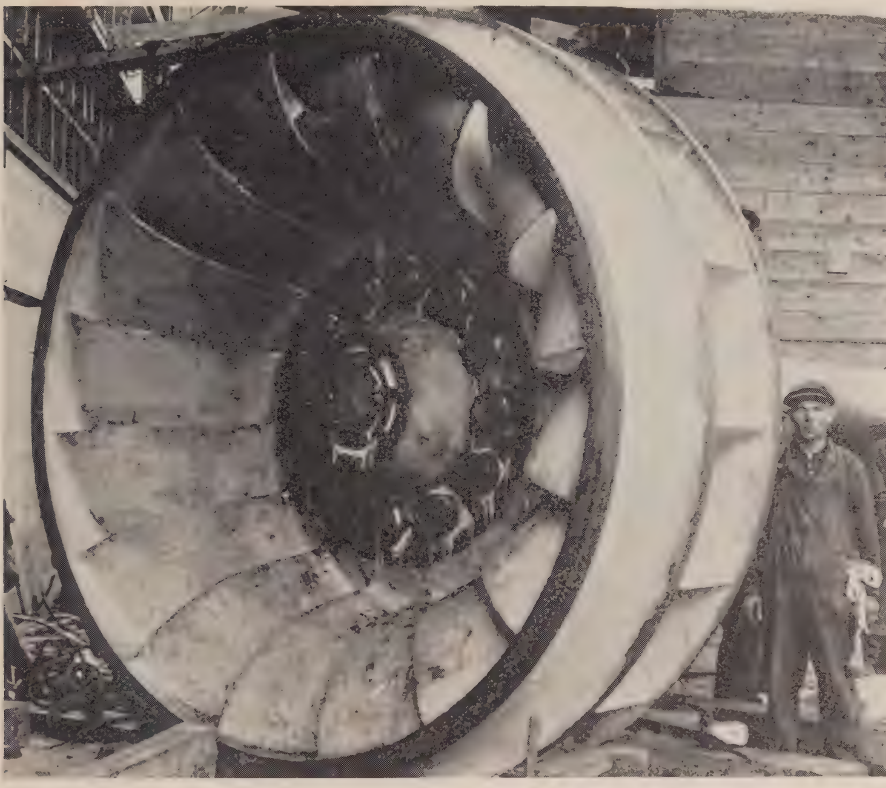
*Cross-section Chats Falls Power House. Propeller runners set below tailwater level to prevent cavitation and reduce pitting.*

characteristics and requirements of the generator for various conditions, and to weigh carefully the advantages of the possible number of units.

The design of the power house substructure is now proceeded with, being to a large degree fixed by the water passages, the unit spacing and the area required for the various mechanical and electrical apparatus.

In plants with higher heads requiring penstocks, the fixing of the size and number of the units of course determines the penstock arrangement and diameter in large measure. The diameter, however, will finally be determined only after investigation of the economic size and the speed regulation of the units. It may be said that the power house substructure is very largely dependent on the hydraulic equipment and arrangement, whereas the superstructure is fixed by the requirements of the electrical apparatus.

The tailrace, unless of unusual



*Above—Queenston Runner—Francis or low specific speed type. 55,000 h.p. under 294 feet head.*

*At Right—Chats Falls Runner—Propeller or high specific speed type. 28,000 h.p. under 53 feet head.*

length, may be said to offer no particular difficulties in design, if of great length, however, it should receive the same consideration as a canal.

With these main features more or less fixed, the final design of the various elements is proceeded with. In some instances, however, the final design cannot be made until construction has been started. This is particularly true in regard to the dam and other water-controlling structures, where the necessary information in

regard to the foundations cannot be ascertained until the river channel is unwatered by the construction of cofferdams. In some instances the location and design of the various structures have been fixed in large measure by the construction requirements, very often to assist in unwatering operations or for the passage of flood flows during the construction period. All of the above features require careful consideration before proceeding with the detailed design of structures.

# Clinton's First Electric Lighting Plant

**By J. E. Rands, Clinton Public Utilities Commission.**

THE story of the use of electricity during the early days in the town of Clinton, Ontario, is closely related to the late H. B. Chant, who until his death a few years ago was the superintendent. The memory of him is still fresh to a large number of the electric utility men in Ontario, yet few will be familiar with the growth of the plant of which he was in charge for many years.

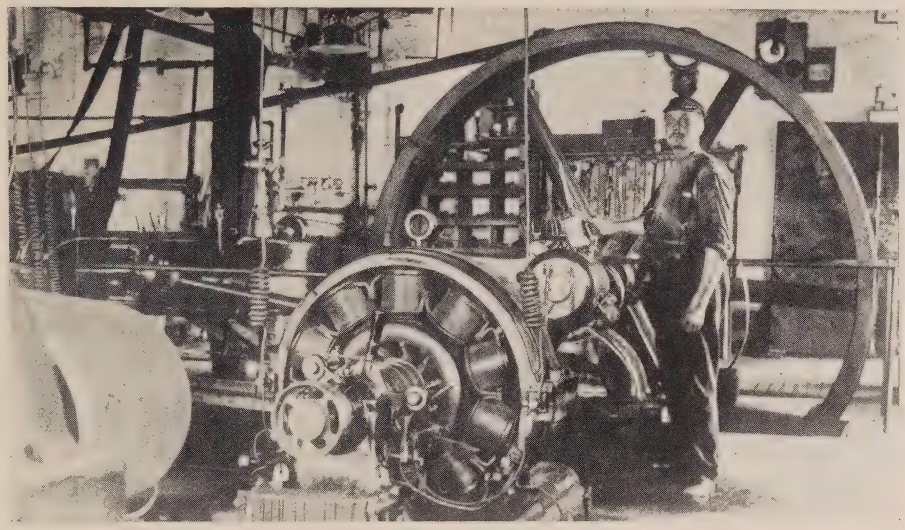
Late in 1888 Mr. Graham of Clinton decided to install electric generators in the engine-room of his woolen mill, so purchased a 60 h.p. boiler and a 35 h.p. engine, together with two reliance system, direct current, arc lighting dynamos of 25 light capacity each. On the 12th of January, 1889, the electric arc lights were turned on for the first time. These were in a number of business places of Clinton, with one street light at the main corners. The people were greatly enthused over the brightness as compared with the coal oil lamps.

During the summer of the same year the Town contracted for ten street lights of 2000 candle power each to be in use 300 nights of the year, the lights to be in order by the 15th of September. The contract was for five years, at a cost of $660.00 per year, or 22c. per light per night. It was subject to rescission on one month's notice if the company failed to furnish the proper light. The lights were to be on until 11 o'clock each night, and by special order of the Mayor, until 12 o'clock.

In October, Mr. Graham leased the woolen mill to the Oakes Organ Co., "afterwards the Clinton Organ Co." He still held his right in the engine-room which was a separate building.

In February, 1892, the Edison Incandescent Electric Light Co. of New York had representatives in Clinton to introduce that system. They received enough encouragement to go ahead with plans for a new plant in opposition to that of Mr. Graham.

The Clinton Organ Co., and Mr. Graham then decided to enter into a contract with the Edison Company and by March 22, 1892, an Edison dynamo of 250–16 candle power lamp capacity had been installed and incandescent electric lights were turned on. The demand for the incandescent lighting increased so rapidly that during the summer of the same year the Electric Light Com-



*The 60 k.w., 133 cycle Generator and Wheelock engine installed in the old Clinton Plant in 1904.*

pany had to enlarge the plant, and in October installed a new 80 h.p. Wheelock engine and another 250 lamp Edison dynamo. This dynamo was connected in series with the one already in operation, and the Edison three wire system used.

In August, 1893, the Clinton Organ Factory was burned, leaving the engine and boiler-room, which after this, was used entirely for the generation of electricity.

In the summer of 1895 the Electric Light Plant was again enlarged, a new 80 h.p. boiler and a new Canadian General Electric 133 cycle, 1100-volt generator of 1000-16 candle power lamp capacity being installed. This was put in operation in October.

During this same month the Town made a new four year contract for street lighting at 20c. per light per night, the lights to be left on until 12 o'clock midnight. About this time the Huron County Home was being built about a half mile south of Clinton, and the County contracted for electric lighting.

In the year 1900 the Electric Light Co., installed a 70 h.p. Leonard Ball high speed engine to help the Wheelock engine.

Mr. Graham sold the plant in 1903 to Messrs. Stevenson and Nediger, and in 1904 the new company installed another 60 kw. Canadian General Electric a.c. generator, the same as the one already in use.

The Clinton Knitting Company in 1906, built its present factory on the ground formerly occupied by the Clinton Organ Factory. This company contracted with the Plant for electricity for power and light, steam for heating and dying, and for water. The Electric Light Company then in-

stalled a Canadian General Electric 30 kw. 250-volt direct current generator for power supply.

The arc lighting system (which by this time served 18 street lights) was discarded in 1910 and an 8 k.w., C.G.E., 4.4 ampere, constant current transformer and 121 incandescent series street lights were installed to take its place.

The Town bought the electric plant and took it over on the 1st of June, 1913, having entered into a contract for Hydro power during April of that year. At this time there were 5 power customers, 104 commercial consumers and 146 domestic consumers. There were 195 a.c. 110-volt meters and 1 direct current meter, 250 volts. In the spring of 1916 the Town closed down the steam plant as the contract with the Knitting Company had expired and had built its own boiler-room and installed Hydro for power.

* * * *

THE BULLETIN is always pleased to publish short histories and illustrations of the old electric plants formerly used in Hydro municipalities.

## Electricity in Lhasa, Tibet

A recent number of *The Electrical Times* contains a brief description of equipment required by the Tibetan Government in April, 1930, for an extension to a hydro-electric system placed in service in 1927 and was not fully loaded. Without going into details of the desired equipment the following has been extracted from the description as being of passing interest

The inquiry called for step-up transformers to be installed in the generating station, a 3,300 volt overhead line to a munition factory at Debchi, some three miles from the generating station, and for the extension of this line to Lhasa, approximately a further three miles. At the munition factory the power was required for machine drives and as this factory only works during the daytime it was desired that the overhead line should be led into the factory through a change-over switch. When the factory was shut down at the end of each day the extension was to be switched over to the line to Lhasa, as the load in that town is purely a lighting one.

The transport of this material presented considerable difficulty. Lhasa is some 400 miles from railhead in Himalayan Range, and only the roughest and narrowest of tracks are found. Lhasa itself is on a plateau about 12,000 ft. above sea level, but, to reach it, passes up to 17,000 ft., have to be negotiated. The transport is by means of mules which are changed about half way to yaks and porters. In consequence the firm was requested to keep the weight of all cases down to 80 lbs. This was, of course, impossible for certain parts, and considerable trouble was experienced in transporting the necessarily heavier cases. In all, 482 cases were sent forward from India into Tibet.

Nothing further was heard regarding this plant until last June, when the Company received a letter from Lhasa, an extract from which read:—"You will remember that the order for the Lhasa lighting equipment was held in abeyance pending satisfactory

erection and working of the transformers and transmission line supplying power to the factory from Dordi. After a year's continuous working the equipment so far supplied by you has given us every satisfaction so that we now desire to proceed with the scheme for lighting Lhasa."

It may be of interest to record that the order which accompanied this letter was written in Tibetan on rice paper and measured 24 by 47 inches. It was signed with the seal of the Directors of the Debchi factory and was dated "21st of the Fourth Month of the Water Bird Year". None of the staff attached to the Calcutta office either talks, reads or writes Tibetan and it was fortunate that a typed translation in excellent English was sent on similar paper with a similar seal.

# Synthetic Daylight Aids Poor-Vision Pupils

**By W. R. Flounders, General Electric Vapor Lamp Company, Hoboken, N.J.**

SOME of Philadelphia's schools have rooms given over to "sight-saving" classes. In these classes are gathered from all over the city children whose eyesight is so poor that they are incapable of carrying on ordinary school work. Here skillful, specially trained, sympathetic teachers are devoting their lives to make it possible for these unfortunates to earn a living in some way and not become a charge for public charity. Many of the children would hold a book printed in extra heavy type within three or four inches of the eyes. Some stood within a foot or two of the blackboard to read figures three inches high made with extra heavy chalk. All pictures on the wall had the important part heavily outlined in India ink. All the desks are easily adjustable and movable, so important is it that the students should be able to use daylight to the best advantage and also to get very near the blackboard or charts which were being studied. In spite of the abundance of window area and good, well-diffused artificial lighting, they were especially irritable on dull or rainy days.

The school authorities recognized the fact that there was much room for improvement in the artificial lighting and were eager to find a solution of this problem. A careful study of the situation indicated that one of the major difficulties was the difference in color between the artificial and the natural lighting. There was a marked tendency on the part of the students to look at the lighting units when they were energized.

Accordingly it was arranged to equip one room on the northeast corner of the building temporarily with a synthetic daylight installation —that is, a unit containing both incandescent and mercury tube lighting properly blended—and study the effect.

The results of this experiment far

exceeded any expectations. The ratio between incandescent and mercury tube lighting was carefully adjusted to blend with natural lighting on an overcast day. When complete it was impossible to tell where daylight left off and artificial lighting began, so closely did one merge into the other. The students were able to see much more easily. In certain cases it was noted that the student held his eyes much farther from the printed page than he had under ordinary lighting. The teachers found their supervision no more difficult on a rainy day than in fair weather. Many educational authorities and experts on this special kind of teaching had an opportunity to study this installation and all voiced approval. It unquestionably had stepped up the seeing power of these unfortunates to a very marked degree. The room is housed in a rather old building and is 24 by 26 ft. with a 15-ft. ceiling. Windows extend to nearly the entire width of the north side and about two-thirds of the east side.

This lighting installation is significant since it points toward a direction in which future lighting may very well go. The fact that such expert observers as sight-saving class teachers and prominent educational and medical authorities are convinced that in this particular case light that blends with daylight is easier on the nerves than with uncorrected light from incandescent equipment indicates that the nerve strain on people with normal eyesight may be greatly lessened by artificial lighting which is corrected in quality and possesses as well the other essentials of good illumination.—*Electrical World.*

# Many Interruptions to Electric Power Supply are Avoidable

By Robert Treat, Central Station Engineering Department, General Electric Company

THERE are 31,536,000 seconds in an ordinary year and 86,400 more in a leap year. When it is considered that in each of these seconds there lie a number of more or less unexpected possibilities of trouble in furnishing electric service, it is evident that most central-station companies maintain a very creditable record for continuity of power supply. The standing of the leaders in this respect has been attained by encouraging the operating staff to be ever alert in routine and emergency matters and by adopting improved operating procedures and equipment which become available from time to time.

During the past few years several central-station companies have made an outstanding improvement in the continuity of their service by maintaining what is in effect a continuous supply of power to the loads on a feeder in spite of momentary short circuits on the feeder. This has been done by eliminating the intentional delay that previously had been employed before attempting to re-energize a feeder after a short circuit. The new operating procedure has been made possible by changing the automatic control of the breakers from delayed reclosure to immediate reclosure. The experience of these companies has shown that nine times out of ten this method of operation restores service so quickly the customer does not know his power was ever off—his production is not halted and the quality of his product is not impaired.

When considering such an operating program certain questions naturally arise. They arose in the minds of the engineers who first tried immediate reclosure. In seeking the answers to these questions, various investigations and studies were made.

There has been a constant trend toward the reduction of the time interval between a tripout and the first attempt to re-energize the interrupted circuit. In the early days, when central stations first began to reach out to supply industrial loads, it was customary to wait two minutes to give motor users with manual-control equipment sufficient time to get clear of the line. This old type of control equipment, without undervoltage protection, has now largely disappeared. With the advent of automatic reclosures, the delay before the first reclosure was reduced first to one minute, then to 30 sec., and now many make the first attempt in 15 sec. This shortening of the time interval has not been accompanied by any appreciable reduction in the number of successful first reclosures; and obviously a 15-sec. interruption is less disturbing than one of two minutes.

But why delay at all? Might it not be possible to re-energize the circuit immediately, so that the lights would merely blink, the motors would keep on running, and production would continue without interruption?

During an entire season four operating companies kept careful records of the performance of all their breakers then equipped with existing forms of automatic reclosing devices. The interval before the initial reclosure of these breakers varied somewhat, but was generally not less than 15 sec. These records covered a total of about 2900 initial tripouts, and showed that approximately 87 per cent. of the time the breakers remained closed after the first reclosure. Evidently, whatever caused the short circuit—lightning, sleet, trees, or something else—had disappeared nearly nine times out of ten during the 15 sec., the circuit was dead.

How much of this interval did it really take for the cause of the short circuit to disappear? It could be reasoned that in many cases, such as lightning, it should clear instantly; but only by experiment could this be definitely determined. Tests made with artificial short circuits uniformly cleared in less time than that in which the breaker could be reclosed—even with no intentional delay in reclosing. While these tests did not furnish conclusive evidence of the practicability of immediate reclosure, they were so encouraging as to warrant making a trial of the immediate-reclosure scheme under actual service conditions.

One company during the first season's trial had 57 tripouts on two circuits provided with immediate-reclosure control. Of these, 46 remained closed the first time—a batting average of 81 per cent. By the next season three companies had extended the installation of immediate-reclosure control to many additional circuits. During that season, with 1659 initial tripouts on the circuits so equipped, the breakers stayed in on the first reclosure 73 per cent. of the time. The engineers of these companies felt that even this record could be improved; they believed that many of the times when a breaker failed to stay in on the first reclosure it was not necessarily because the fault was not off the circuit but perhaps because of mechanical difficulty in the breaker itself, failure of protective relay contacts to open in time, or some other reason which might be easily remedied.

An intensive effort was made by one company to find and correct all such difficulties. Its record for the next season was 88.7 per cent. successful first reclosures out of 1010 initial tripouts. During that season, therefore, this company's record with immediate reclosure was slightly better than the average of those of the four companies two years earlier when initial reclosures were not attempted until after an interval of about a quarter of a minute.

What does this new operating procedure mean to the consumer? To those who use only light, nine times out of ten it substitutes a mere blink of the lights for an interval of darkness lasting 15 sec. or more. Perhaps to the domestic user this is of no great importance, but to stores, hospitals, theaters, and places frequented by large crowds even a 15-sec. loss of light may often be very annoying, if not dangerous. To the industrial user, the new procedure is especially valuable. It eliminates the slowing down of production which accompanies loss of light alone for a 15-sec.

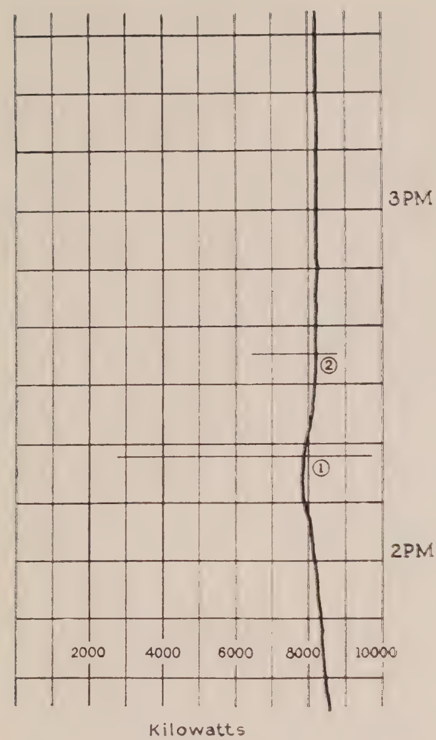



*Fig. 1—A Wattmeter Chart typical of the virtually continuous service furnished by feeders equipped with immediate-reclosing control.*

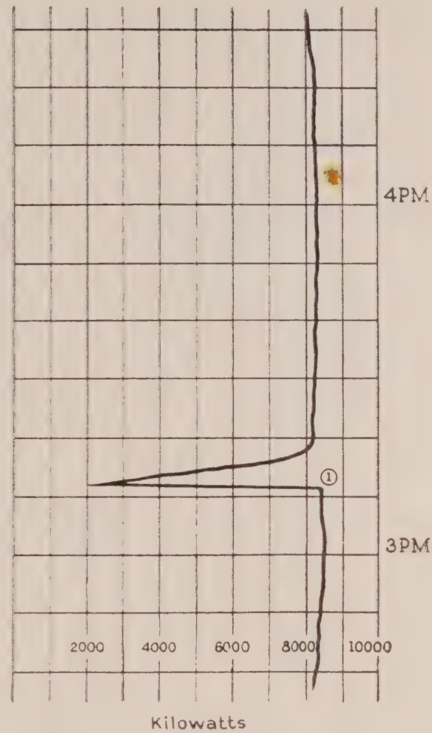



*Fig. 2—Wattmeter Chart which, compared to that in Fig. 1, shows the loss of power revenue and the inferior service following a tripout on delayed-reclosure feeders.*

interval; and where suitable auxiliary devices are used in connection with motors, it is possible to prevent interference with their output. Thus it is possible to virtually eliminate the effect of many of the short circuits by permitting these faults to de-energize the feeder only momentarily; with the result that they no longer cause customer shutdowns. Experience with this practice has demonstrated that it is often possible to hold from 90 to 100 per cent. of the loads where the customers' motor-control equipment has been properly co-ordinated.

The value of such service, compared to that in which time delays are introduced, is shown by a comparison of the wattmeter charts in Figs. 1 and 2. The chart in Fig. 1 represents the load on a 38-kv. bus to which three radial feeders are connected. The two momentary kicks indicate typical tripouts followed by instantaneous reclosure of the feeder breakers. The first of these kicks is the record of the simultaneous tripout and immediate reclosure of two feeder circuits while carrying a total load of 5500 kw. The second is that of like service on one feeder supplying 1500 kw.

Fig. 2 is the record of a circuit not equipped for immediate initial re-

closure. The chart represents the load on a 38-kv. bus to which four radial feeders are connected. The drop in load resulted when a heavily loaded feeder relayed out and was reclosed one minute later. Because of this tripout, the power company lost the revenue from 350 kw-hr. but this loss was negligible compared to that of the industrial customers whose manufacturing processes were abnormal for at least seven minutes. The effect illustrated here is typical for circuits not equipped for instantaneous initial reclosure.

That goodwill is really created by the use of immediate reclosure is shown by the following experience of the operating engineer of one of the power companies that has adopted the new operating procedure. A long radial 44-kv. feeder in a bad lightning territory supplied several small towns, some of which boasted a weekly paper. There had been particularly acid editorial comment about the service the power company was rendering. The breaker on this feeder was then arranged for immediate reclosing. Editorial comment on the service ceased, and after three or four months of silence reappeared; but this time it was complimentary for the excellent service being rendered.

The effect of the practice on the cost of breaker maintenance is indicated in the report of one operating engineer, who says: "In applying the duty cycle of 0-15-120 sec. we have, in many instances, ignored derating factors. During the past two and one-half years we have experienced over 3000 tripouts of breakers equipped for instantaneous initial reclosing, and in more than 200 instances the breakers reclosed before the fault had cleared, and were consequently required to interrupt a short circuit a second time within one second. To date, not one breaker failure is traceable to the second opening, or, as a matter of fact, to the third or fourth openings."

The experience to date has been largely with radial feeders of voltages up to 110 kv., but in addition there has been some application made to tie lines. Those feeders which are subject to frequent short circuits of a transient nature are the most fertile places for the application of immediate reclosure.

It is not necessary to restrict the application of immediate reclosure to unattended stations with automatically reclosing breakers. Relays are available for application to either attended or unattended stations and for all types of oil circuit breakers. A simple one-shot recloser has been developed especially for use in attended stations, when it is desired to make one immediate reclosure automatically but leave to the attendant the subsequent operation of the breaker if it fails to stay in the first time.

There are several factors to be considered when applying immediate reclosure, some of the more important being breaker mechanism, protective relays, existing reclosing devices, loads and tie lines.

*Breaker Mechanism:* It is necessary that the breaker mechanism be allowed sufficient time after tripping to relatch before the reclos-

ing impulse is given. This is best taken care of by a latch-checking auxiliary switch directly on the mechanism and connected in series with the reclosing coil of the oil circuit breaker or its operating relay.

*Protective Relays:* The relays which trip the breaker obviously must open their contacts before the breaker recloses, or it will immediately trip a second time even if the fault has cleared. Some of the older types of induction relays do not always do this unless modified.

*Existing Reclosing Devices:* It is possible to modify the timers of most existing reclosers to permit an immediate first reclosure; or an auxiliary relay to accomplish the same purpose may be added.

*Loads:* Ordinarily, immediate reclosure does not subject the load to conditions greatly different from those now encountered because of voltage dips caused by short circuits on adjacent feeders. Immediate reclosure therefore can usually be applied to a circuit without making any changes in the control of the loads supplied by it.

*Tie Lines:* When immediate reclosure is applied to tie lines having sources of power at both ends, it is usually necessary that both ends be opened before either end is reclosed.

Ordinarily, power users are not obliged to make any modifications in their equipment when a change-over is made to immediate reclosure. However, the user who makes no change in his own equipment will probably receive but little benefit. To obtain the full advantages of the new operating procedure, which is primarily intended for his benefit, he need add only the necessary time-delay under-voltage devices, field-removal relays, unloading devices, etc., to the control of the motors and loads that it is profitable to keep in operation through disturbances. Incidentally, when he makes these changes, he obtains additional benefits in the form of practical immunity from troubles resulting from voltage dips caused by faults on adjacent circuits. Squirrel-cage induction motors will generally need only a simple time-delay under-voltage device. Wound-rotor motors will require the same, except in some cases where the motor may drop below 50 per cent. speed; in this case it is advisable to arrange the control so that some resistance will be inserted in the rotor circuit. If synchronous motors are not disconnected from the circuit it may be advisable to remove their fields to prevent them from keeping the short circuit alive, and to assist in re-synchronizing when the circuit is re-energized. In some cases it may be necessary to provide some means of unloading the motor in order to facilitate resynchronizing.

In conclusion, operating experience has demonstrated that: (1) there is no need to delay re-energizing most power circuits; (2) by proper co-ordination of users' control equipment it is possible to carry 90 to 100 per cent. of the circuit loads through a short circuit without loss; and (3) many industrial processes which are completely ruined by a 15-sec. interruption are not in the least affected by a short circuit when immediate reclosure is adopted.

—*General Electric Review.*

# Bibliography of Lightning Protection for Distribution Circuits

Compiled by R. E. Jones, Assistant Engineer, Distribution Section
Electrical Engineering Dept., H.E.P.C. of Ont.

(*Continued from May*)

*Electrical Distribution Engineering. H. P. Seelye. P. 240. 1930.*

An arrester consists of a gap or gaps to flash over with excess voltage only, together with some means of preventing the power arc following.

A simple horn gap makes use of the fact that an arc rises and blows itself out. It does not discharge as fast as other forms and may cause a surge in the circuit.

Speed of discharge must be fast enough to relieve line promptly.

In some arresters an increase in current raises the resistance to discharge. With others the reverse is true.

Voltage at which discharge starts should not be low enough to discharge at unimportant surges, but not too high. 2 to 2½ times normal line voltage is common.

Some arresters will withstand more repeated discharges than others.

When damaged some arresters clear themselves from the line.

Arrester ground and lead should have as low an impedance as possible.

The frequency of arrester locations should be considered from an economic standpoint, not neglecting the value of service.

Arrester should be as near as possible to the apparatus it protects. However, a few feet of circuit should not affect the action of an arrester.

An arrester usually will not prevent a surge entering apparatus. Its function is to discharge quickly enough after the surge to prevent damage to insulation by a rise in voltage.

*Theory of a New Valve Type Lightning Arrester. J. Slepian, R. Tanberg, and C. E. Krause, Westinghouse Elec. & Mfg. Co. A.I.E.E., Jan. 1930.*

The "Voltage ratio" of an arrester is explained. It is the ratio of the largest voltage appearing across an arrester to the cut-off voltage.

The characteristics of electrical insulation are such that a voltage ratio of 2 or 3 will give almost perfect protection.

A valve type arrester must change from a good conductor to a relatively good insulator over a moderate change of voltage.

The glow discharge principle of the old Autovalve arrester is described.

Another method of obtaining a discharge which requires for its maintenance a voltage comparable with that required to initiate the discharge is to confine the discharge to narrow passages with insulating walls.

Tests were made with different porous insulators, including red building brick.

To obtain a low voltage ratio a material of extreme fineness is required. The addition of a small amount of powdered conducting material lowers the break-down voltage without affecting the cut-off voltage.

*Development of the New Autovalve Arrester. J. Slepian, R. Tanburg, and C. E. Krause, Westinghouse Elec. & Mfg. Co. A.I.E.E. April, 1930.*

Present available arresters are limited in their performance because of their size. They may be expected to reduce lightning damage to an unprotected system to one tenth to one-twentieth.

The development of a new type of arrester has been possible with the assistance of the klydonograph and the cathode-ray oscillograph.

The new Autovalve arrester has a voltage ratio (discharge voltage over cut-off voltage) of 2.5 which is greater than with the older type of arrester. Laboratory tests have shown that voltages in excess of this ratio will not damage insulation.

The valve characteristics of the new arrester are based on the properties of electrical discharges confined to narrow passages. A porous block of slightly conducting material is used for this purpose.

Experiments were made with various types of blocks using a clay with different conducting materials added. The voltage ratio was found to vary with the coarseness of the structure of the block.

A spark gap is placed in series with the valve element.

The new arrester is considerably smaller than the older model.

*Thyrite—A new material for Lightning Arresters. K. B. McEachron, General Elec. Co. A.I.E.E. April, 1930.*

A new material has been developed which is particularly adapted for use in lightning arresters. It can be moulded into any form and physically it is similar to dry process porcelain.

The resistance of this substance decreases as the voltage increases. If the voltage is doubled the current is increased 12.6 times. Its characteristics are not affected greatly by temperature or time.

This is used in three forms of arrester:—

Station type in 11.5 kv. sections with self-contained gap.

Distribution type which is smaller than station type and has but one quarter of impulse current capacity. For discharge currents up to 1000 amperes neither arrester will allow crest than 2.8 times arrester rating in more volts to appear across it.

Insulator type.

The Thyrite arrester is smaller than previous forms.

Thyrite has no appreciable time lag.

In the distribution type arrester for 3 kv. two discs 3 in. in diameter and 1 in. thick are used.

In the discussion, E. Beck regretted that further information was not given regarding the composition of Thyrite. He asked if test had been made in another laboratory on building brick which showed a valve action.

*Lightning Protection for Industrial Substations. H. M. Towne, General Elec. Co. G. E. reprint from "Industrial Engineering" June and August, 1930.*

Description of the requirements for the protection of substations.

* * * *

*The Surge Dielectric Strength of Transformers. E. T. Norris, Ferranti Ltd. "Electrical Review". Jan. 23 and 30, 1931.*

*Reprint of Ferranti Ltd.*

The distribution of surges in a

transformer winding and the effect on the insulation is covered in detail.

This is followed by a discussion on means of reducing the stresses set up, both by grading the insulation, and by using external surge absorbers.

*High Voltage Testing. F. D. Fielder, Westinghouse Elec. & Mfg. Co., "Electrical Journal". Feb. 1931.*

The construction and use of the Cathode-ray Oscillograph are discussed.

*Line Type Lightning Arresters. Catalogue, Can. Gen. Elec. Co. March, 1931.*

Description and physical data on various types of Pellet Arresters.

*Instruments for Lightning Measurements. C. M. Foust, Gen. Electric Co. "G.E. Review". April, 1931.*

A description of various types of surge recording and measuring instruments as made by General Electric Co., and the application of same.

*Thyrite Lightning Arresters. Catalogue of General Electric Co. April, 1931.*

A description of station type Thyrite arresters with performance curves under various conditions.

*Protection of Electrical Apparatus from High Voltage Surges. E. T. Norris, Ferranti Ltd., International Conference. June, 1931.*

The effect of impulse voltages on electrical apparatus is discussed followed by a description of the Ferranti Surge Absorber.

The paper is similar to one by Mr. Norris in *Electrical World* of Jan. 26, 1929.

*Field Tests on Thyrite Lightning Arresters. K. B. McEachron and E. J. Wade, General Electric Co. June, 1931.*

The authors describe tests made on a 45 mile steel tower line protected by Thyrite Station type arresters. A portable cathode-ray oscillograph was used. Impulse voltage of 1,500,000 volts was obtained from an impulse generator consisting of 60 banks of capacitors charged in parallel to 25 kv. and discharged in series.

* * * *

*Advance Guards 1737-F. Catalogue of Canadian Westinghouse Co. 1932.*

A short description of lightning conditions followed by limited data on the full range of the new Autovalve arresters.

*Surge Absorbers Bulletin No. 700. Catalogue of Ferranti Electric Ltd. Jan., 1932.*

A short description of the operation of a Ferranti Surge Absorber including a Cathode-Ray Oscillograph showing a steep wave front surge before and after passing through an absorber.

Operating experience in various parts of the world is given.

*Surge Proof Transformers. H. V. Putnam, Westinghouse Elec. & Mfg. Co. A.I.E.E. Jan., 1932.*

This describes the construction of high voltage transformers.

*Surge Proof Distribution Transformers. J. K. Hodnette, Westinghouse Elec. & Mfg. Co. "Electric Journal". Feb., 1932.*

This is a description of a transformer protected by Deion Gaps between primary and case.

*Studies in Lightning Protection on 4 kv. Circuits III. D. W. Roper, Commonwealth Edison Co. A.I.E.E. March, 1932.*

The lightning generator was de-

veloped about 1921 but a spark gap was the only measuring instrument. In 1924 the Cathode-Ray Oscillograph was developed in suitable form.

In 1926 laboratory tests placed arresters in a different order of merit from Chicago field results. Many conferences were held with manufacturers at which all points of each arrester were discussed.

In 1931 in Chicago there were 33,093 transformers on overhead lines supplying 800,000 customers. The tanks were not grounded.

There are now 15 types of 3 kv. arresters on the system. The city is divided into 162 areas with only one make of arrester in each area.

Of 474 transformers burnt out and examined, nearly one-half as many have trouble starting on secondary as starting on primary. If induced charges on secondary cause damage this should also be apparent on customers premises. For 3 years average cost of repairing customer's equipment thus damaged was less than $100.00 per year. About 40 meter failures per year appear to be due to lightning.

About 5 per cent. of transformer failures are due to direct strokes.

In two cases it was determined that maximum surge was of the order of 400 kv.

Contrary to expectations the records show the failure rate for transformers at the end of a primary to be 20 per cent. below those at other locations.

Only 7 per cent. of burnouts due to lightning on transformers less than 5 years old. Over 75 per cent. on transformers over 10 years old.

The extra cost of reducing arrester grounds below 50 ohms is not warranted.

The shielding of trees and buildings has no effect on induced charges.

The best results were obtained with an arrester withdrawn from the market 10 years ago. It had a wood box containing series gaps with shunt resistances. It required annual inspection and maintenance. Other old types showed better performance than valve type which were first installed in 1922.

The following are suggested:—

1. Use 4 wire 3 phase distribution with grounded neutral.
2. Where transformers or cables are connected to overhead lines use arrester suitable for Y voltage. Avoid duplication within 500 feet.
3. Use transformers with insulation that will not deteriorate with age and which will withstand voltages which may be expected in service.
4. If conditions warrant the use of a second ground rod, use also a second ground wire down the pole.
5. Ground each service to the water pipe.
6. Connect the secondary neutral to at least two ground rods and one at least each 600 feet.
7. Interconnect the secondary neutral of adjacent sections.
8. Interconnect the lightning arrester ground and the secondary neutral when the latter is well grounded.
9. When transformers are 1500 ft. or more apart install an arrester on a pole about 600 feet from the transformer.

10. Ground the lead sheaths of all underground cables.

In the discussion, K. B. McEachron did not agree with Mr. Roper's suggestion of a second ground wire with a second rod. Mr. Roper stated that this was based on results of tests at Purdue University and Westinghouse Laboratory.

A. M. Opsahl did not agree that expense of getting grounds below 50 ohms was not warranted. Mr. Roper had no experience with very high ground resistance.

In Chicago there had been no accidents from ungrounded tanks. In an inspection in 1931 one tank out of 30,000 was found "hot".

*Discussion on Distribution Lightning Protection Synposium presented at Winter Convention of A.I.E.E. 1932. A.I.E.E. March, 1932.*

H. C. Dean—Papers refrain from showing it would also be desirable to connect transformer case to secondary neutral. In New York Edison System it has been found that a known hazard is to be preferred to an unknown one and grounding of cases now standard practice.

The papers have shown that a large number of transformer failures do not result in the destruction of the transformer but merely result in a ground of a primary lead to the case. Due to insulation of the pole this may not be detected at once with an ungrounded case.

Several years ago a lineman was killed by coming in contact with a case while working on secondary wire. As a result a survey was made of all transformers and seven cases were found at full primary potential. An annual survey was then made and each year one or two additional transformer cases were "hot".

Standards in New York since July, 1931, are as follow:—

1. Lightning arrester ground leads shall be connected to the secondary neutral.
2. Lightning arrester ground leads shall be connected to driven grounds at the poles if there are less than two water pipe service grounds connected to the secondary neutral on the pole or poles not more than one section away from the lightning arrester.
3. Lightning arrester ground leads shall be connected to the primary neutral (if any exists).
4. Transformer cases shall be connected to the secondary neutral.

A. H. Schirmer—Tests made by the Bell Systems on equipment other than power transformers indicated that to give lightning protection to transformers the arrester should be connected between primary lead and secondary neutral. This system is used on open wire loading coils.

In our opinion connecting the arrester between primary and secondary neutral makes for an increase in safety on the premises of the consumer, provided a suitable arrester is used. The maximum safety is reached when an arrester is used having a current limiting element so designed that the voltage across the transformer windings is held to a value slightly below the impulse strength of the transformer.

It is the excessive power voltage

rather than lightning surges which make for hazard on the premises of the consumer.

E. Beck (Westinghouse Elec. & Mfg. Co.) Surge voltages on house services can be reduced to negligible values by the use of 110 volt lightning arresters or small capacitors between phase wire and neutral at the house entrance.

K. B. McEachron.—With any modern arrester connected inside the primary fuses the lightning discharge currents will pass through the fuses and may blow fuses below 5 ampere rating in case of extremely severe discharges.

*Distribution System Lightning Studies H. A. Dambly, H. N. Ekvall, and H. S. Phelps, Philadelphia Elec. Co. A.I.E.E., March, 1932.*

Investigations of lightning troubles on the distribution system have been made by Philadelphia Elec. Co. since 1921.

In 1930 there were 23,000 aerial transformers.

Cases of transformers are not grounded.

The average arrester ground is 100 to 150 ohms.

Records were kept of all lightning troubles with different circuits and connections

Small transformers are more susceptible to lightning than are larger ones. This fact must be taken into consideration in analysing arrester performance.

Arresters are of little benefit to transformers of 15 kv-a. and less.

Low arrester ground resistance may be obtained by interconnection of arrester ground and secondary neutral where latter is well grounded.

*Lightning Protection for Distribution Transformers. T. H. Haines and C. A. Corney, Edison Elec. Illuminating Co., of Boston. A.I.E.E., March, 1932.*

In the Boston area ground resistances are very high, the soil being generally sandy and rocky. The distribution system is 4000/2300 with the primary neutral ungrounded at stations or elsewhere.

For years lightning storms have caused much fuse blowing and damaged transformers.

Lightning arresters were not used extensively due to the common opinion that they were of little value with high ground resistances.

In 1925 a number of arresters were installed at certain locations provided a ground resistance below 250 ohms could be obtained. It was soon found that this resistance was hard to obtain and the limit was raised to 1000 ohms.

Operating results were tabulated and in 1929 the ground limit was raised to 2000 ohms.

The average ground resistance is above 200 ohms.

On resistances below 100 ohms it was found that the effectiveness of arresters was definitely increased but with resistances higher than 100 ohms the effectiveness of the arrester is not materially affected by increased resistance

Insufficient electrical clearances in the smaller and older transformers is the cause of much lightning trouble.

*Impulse Voltage Tests on a 4,800 Volt*

*Distribution Substation. H. W. Collins and E. E. Piepho, Detroit Edison Co.; J. J. Torok, Westinghouse Elec. & Mfg. Co. A.I.E.E., March, 1932.*

To determine the cause of flashovers in substations started by lightning impulse tests were made on a typical substation.

The 4800 volt ungrounded circuit enters the substation through a length of cable. Arresters are installed at the junction of the overhead line and the cable and also on the station bus.

At the regulator the surge impedance of the windings is of such magnitude that the impulse wave is built up by reflection.

*Interconnection of Primary Lightning Arrester Ground and the grounded neutral of the Secondary Main. C. F. Harding and C. S. Sprague, Purdue University. A.I.E.E., March, 1932.*

To investigate the relative value of various transformer connections and the protective devices, an experimental line was set up. On top on a standard cross-arm was the 4000 volt 4-wire circuit and below on a crossarm were 230 volt 3-phase power and 115/230 volt single phase secondaries. This line was run for 5 spans. It included a bank of transformers and a customer's service but was not connected to a 60 cycle supply. 12 inches above the 4000 volt circuit was placed a series of wires representing a cloud. At intervals this was charged by means of a surge generator.

Various connections were made and tests made with the surge generator.

Efficient primary protection upon an overhead distribution system affords a considerable degree of protection to secondaries located below the primaries.

A well grounded secondary neutral wire acts in reducing potentials on adjacent wires.

With existing transformer design, the insulation of the secondary winding may be considerably overstressed by steep wave front surges without excessive stress on the primary insulation.

Such secondary stresses may be relieved by improvements in secondary insulation.

Low ground resistances, although desirable in other respects, do not necessarily reduce the initial potentials which may be induced upon the system.

A non-inductive load in the consumer's premises reduces the potentials 60 to 70 per cent. at the service entrance.

Tests have shown that the interconnection of primary lightning arrester ground to the grounded neutral of the secondary main effects a considerable reduction in voltages at the transformer and imposes no extra hazard upon the consumer's wiring.

With interconnection of grounds there is benefit only when the secondary neutral ground is of lower resistance than the arrester ground.

With the usual city conditions consisting of a multiplicity of low resistance grounds on the secondary neutral and the further possibility in some instances of a lightning arrester ground of high resistance, it has been demonstrated herein that potentials at the transformer may be greatly reduced by the interconnection of the primary lightning arrester ground and the

grounded neutral of the secondary main.

*Lightning Protection for Distribution Transformers. K. B. McEachron, General Electric Co., and L. Saxon, Utility Management Corp. A.I.E.E., March, 1932.*

Experience has shown that while the application of lightning arresters has reduced the number of transformer failures and fuses blown, the protection is not as good as should be expected from the performance data on the arrester.

For tests a 4.45 mile single phase 4600-volt rural line was used. The insulation at guyed poles was increased to prevent flashover. At one end a 10 kv-a. transformer was installed. Secondaries of a total length of 3,273 feet were connected to this transformer. One service was connected to the secondary bus. The secondary neutral was grounded at 5 points in addition to the service giving a combined resistance of 25 ohms. The primary line was energized at 2,300 volts.

A portable surge generator was used to apply a 350 kv. impulse at the start of the line. This resulted in a 123 kv. 6/14 micro-second wave at the other end of the line at the transformer.

3 kv. and 6 kv. Pellet arresters were used.

Tests were made using various connections as regards arresters and grounds. Readings were taken at various points on the secondary system.

With the present connection of arrester ground, the resistance of the ground is very important. It may be low enough for one discharge but too high for another.

Impulses originating in the secondary circuit cause the tank to rise above the primary and may cause a primary failure. Thus some primary failures may have been caused by a surge entering by way of the secondary.

Grounding the tank to the arrester ground is not helpful as it increases the secondary stress.

Interconnection of primary arrester ground and secondary neutral will reduce potentials during lightning discharges whether originating in primary or secondary circuits.

With interconnection nothing is to be gained by grounding the tank to the secondary neutral.

Interconnection of grounds allows impulse current to flow in the secondary network. Lightning discharges which induce voltage in the secondary have the same effect but interconnection increases the number. Where neutral is grounded to a water pipe this should not increase the hazard. In rural distribution interconnection may increase the hazard if several different grounds exist on the consumer's premises.

Interconnection will reduce the number of cases of breakdown between primary and secondary windings resulting in power current entering consumer's premises.

Arrester grounds are not necessary where the secondary ground is as low as is obtained with water pipe grounds.

*Lightning Protection for Distribution Transformers. A. M. Opsahl, Westinghouse Elec. & Mfg. Co. A. S. Brookes and R. N. Southgate, Public*

*Service Elec. & Gas. Co. A.I.E.E., March, 1932.*

With arrester ground separate from secondary neutral transformers have flashed over although the arrester should give ample protection.

Surge current flowing to ground through the arrester ground lead gives rise to inductive drop and resistance drop voltages which added to the voltage permitted by the arrester can be great enough to flash over the bushings of the transformer to the secondary neutral.

This voltage is limited by interconnection of grounds.

With ungrounded tank when lightning causes a flashover of bushings to tank and thence to secondary neutral the surge current and power current go to ground through the consumers service neutral, until the primary fuse blows. Apparently this causes no serious damage on the consumer's premises.

At the present time the interconnection of arrester and secondary grounds is forbidden by the Safety Code.

Tests were made under various conditions using a set up similar to that used on a distribution line.

*Impulse Testing with Power Connected H. V. Putman, Westinghouse Elec. & Mfg. Co. "Elec. World". April 9, 1932.*

Description of method used to test large power transformers with an impulse generator with 60 cycle power applied to transformer at same time.

*A Travelling-Wave Primer. E. Beck, Westinghouse Elec. & Mfg. Co. "Elec. Journal." April, May, Aug., 1932.*

Steep front waves are described and analysed graphically.

*Ferranti Surge Absorber Bulletin No. 701. Catalogue of Ferranti Elec. Ltd. April, 1932.*

An illustrated discription of the principle of operation and method of manufacture of surge absorbers.

Results of tests are given. A graph shows the little effect vatiation in ground resistance has on the operation of an absorber.

The theory of the origin and propagation of lightning surges is followed by photos of typical installations.

*Intershunt Thyrite Lightning Arresters. Catalogue Canadian Gen. Elec. Co. May, 1932.*

A description of the Thyrite arrester for installation inside the transformer tank.

*Impulse Characteristics of Fuses. E. M. Duvoisin and T. Brownlee, General Elec. Co. "G.E. Review". May, 1932.*

Tests were made to determine the ability of fuse links of different sizes and types to withstand surge currents.

To blow a 1 ampere fuse the crest of a long-tail travelling wave must be at least 123 kv.

To blow a 5 ampere fuse the crest voltage must be 625 kv.

There is indication that a direct stroke of 50,000 amperes and a few micro-seconds duration may just blow a 10 ampere fuse link.

*Surge Absorbers. G. A. Brace, Ferranti Electric Ltd. Association of*

*Municipal Electric Utilities. June, 1932.*

This paper covers the subject of protection by surge absorbers in detail.

Most of the data in it has appeared in previous papers but is here combined into one paper.

*Improved Methods of Lightning Protection in Power Distribution. H. M. Towne, General Elec. Co. Canadian Electrical Association. June, 1932. C.G.E. Reprint.*

The problem of lightning protection for distribution transformers is reviewed with references to several recent papers on the subject. It ends with a recommendation for inter-connection of arrester ground and secondary neutral.

*Lightning Data and Line Protection. F. W. Peek, Jr., General Elec. Co. "Elec. World." Aug. 20, 1932.*

The production of lightning and its effect on transmission lines is discussed and analysed mathematically.

*Lightning Protection of Distribution Systems and Transformers. Research Bulletin No. 42. C. S. Sprague and C. F. Harding, Engineering Experiment Station, Purdue University. Sept. 1932.*

This book includes data given on interconnection of arrester and secondary neutral grounds covered in A.I.E.E. paper in 1932.

Special attention is given to the resulting impulse voltages at a customer's service.

Readings were taken of the surge voltage at different points on the system with various methods of grounding.

Tests were made and tabulated showing that the voltage breakdown point of an arrester increases substantially with increase in steepness of the wave front.

Flashover tests were made on secondary racks using both 60 cycle and impulse voltages. Dry process porcelain spools punctured easily. The 60 cycle flashover varied from 23 to 33 kv. and the impulse flashover from 44 to 62 kv.

To determine the surge impedance of a ground wire a span of 40 feet was set up using No. 6 solid copper, No. 6 copper clad steel, No. 4 solid copper, No. 4 stranded, No. 2 solid, No. 0 solid, No. 0 stranded copper, No. 1 steel guy cable, and 2 No. 6 solid copper spaced 1 foot. The results varied downward in the order given from 621 to 581 with the exception of the 2 No. 6 wires which gave a value of 360.

A well grounded secondary neutral wire acts to reduce potentials to ground on adjacent wires.

The insulation of the secondary winding of a transformer may be overstressed by steep wavefront surges without excessive stress on the primary.

Low ground resistances, although desirable in other respects, do not necessarily reduce the initial potentials which may be induced upon the system.

A non-inductive load in the consumer's premises reduced the potentials 60 to 70 per cent. at the service entrance.

With arrester ground below 20 ohms, there is little benefit in interconnection of grounds. This is also

the case when both arrester and secondary ground are from 100 to 200 ohms. With low arrester ground and high secondary ground interconnection raised potential across the transformer.

Interconnection is recommended under city conditions with a multiplicity of low resistance grounds on the secondary.

Because of the failure of some of the lightning arresters, tested at only moderate values of surge current, it is recommended that before purchasing new types of arresters, they be tested at a fairly high surge current, say 2000 amperes.

Reduction of the surge impedance of arrester ground leads is best accomplished by the use of a second ground wire down the opposite side of the pole.

*Surge Proof Transformers. H. N. Putman, Westinghouse Elec. & Mfg. Co. A.I.E.E. Sept., 1932.*

This is a description of the method of designing large power transformers so that they will withstand heavy surges. It is followed by a lengthy discussion.

*Surge Protection of Distribution Transformers. P. F. Squier, Westinghouse Elec. & Mfg. Co. "The Electric Journal." Sept., 1932*

The interconnection of arrester and secondary neutral grounds, both by direct connection and by means of gaps is discussed.

With interconnection or as the author describes it—"three point protection" the primary fuse may be placed on the line side of the arrester without danger of surges blowing fuses of 5 amperes and up.

The hazard from leaking arresters may be avoided by solidly grounding the transformer tank.

*Sealed Construction of Lightning Arresters. E. Beck, Westinghouse Elec. & Mfg. Co. "Electric Journal." Oct., 1932.*

Arresters were formerly sealed with gums which prevented flow of water but did not prevent a breathing action.

In 1926 the method of sealing the Autovalve arrester was changed whereby the cap was spun on and the gum used to hold the porcelain cap on only. Tests are made under water with 10 pounds air pressure.

*Distribution Lightning Arresters. Catalogue, Canadian General Electric Co. Dec., 1932.*

Description of Pellet and Compression Type arresters.

*Lightning Experience with new Transformer Connection. T. H. Haines and C. A. Corney, Edison Elec. Illuminating Co., of Boston. A.I.E.E., Boston Section. Dec., 1932.*

During summer of 1932 interconnection of arrester ground and secondary neutral was made on 777 transformers in 7 towns.

For interconnection the following are required:—

1. There must be 3 or more customers with grounded services connected to the secondary or 2 such customers and a ground rod at the transformer.
2. The secondary neutral resistance to ground must not be greater

than 200 ohms and a ground rod must be connected at the transformer if the secondary neutral ground resistance is above 25 ohms.

Data is given showing the benefit obtained by interconnection of grounds.

Considerable transformer trouble has been due to lack of clearance at bushings both inside and outside the tank. A new bushing with a goose-neck was designed and now it is only necessary to carry two sizes of primary bushing in stock instead of the 13 formerly carried.

*Insulation Co-ordination of Distribution Transformers. E. D. Treanor and W. H. Cooney, General Elec. Co. A.I.E.E. Dec., 1932.*

Operating conditions on the usual distribution line and requirements for a co-ordinated transformer are given.

The insulation of a primary distribution line will probably not exceed 400 kv. impulse and most likely will be considerably below this.

Transformer tanks may or may not be grounded.

The insulation of a co-ordinated transformer should be such that if the case is grounded, impulses will arc over the bushings of either winding to ground, or if ungrounded the impulses will flash from one circuit to the tank and from the tank to the other circuit and thence to ground.

This means that the windings must be capable of withstanding all kinds of impulses which will not flash over its bushings.

Arresters are necessary to limit the impulses on the line and to reduce blowing of fuses.

To limit the effect of a surge on the secondary circuit various arrangements are suggested including the use of a capacitor between the neutral and the outer wire to reduce the magnitude of the surge by absorption.

The design of insulation for the windings is discussed.

Results of tests are given with grounded and ungrounded tanks.

*Characteristics of Surge Generators for Transformer Testing. P. L. Bellaschi, Westinghouse Elec. & Mfg. Co. A.I.E.E. Dec., 1932.*

The design of a surge generator is given in detail.

*(To be continued)*

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year


## *A MESSAGE FROM OUR NEW CHAIRMAN*

*Commissioner Roebuck, Commissioner McQuesten and I took office on Wednesday afternoon, July 11th. Since that time conferences have been held and consideration has been given to a re-arrangement of the staff with the object of reorienting the organization, to emphasize the sales side of the Hydro business rather than construction.*

*The Commission desires to say to you that the loyalty of the members of the organization to the Hydro has not gone unnoticed, and that in any such reorganization as may be found necessary the utmost consideration will be given to the past services and the merits of all members of the staff.*

T. S. Lyon

*Chairman.*

JULY 14TH, 1934.

## CONTENTS

Vol. XXI No. 7
JULY, 1934

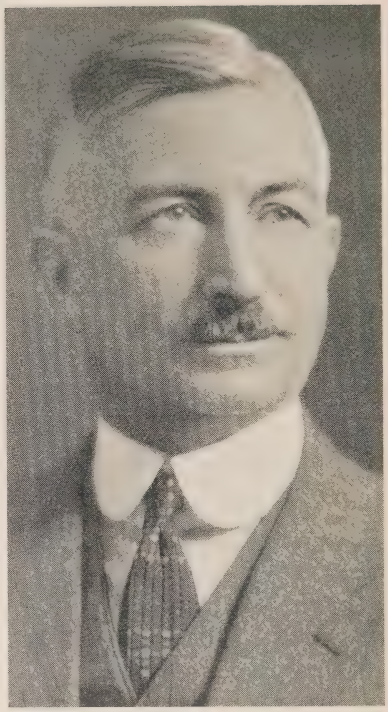


## E. W. Knight—Blenheim

Edwin Wynett Knight of Blenheim, known among his many friends and business associates throughout the south-western portion of Ontario as "Doc", passed away on Saturday, June 23rd, 1934, after an illness of over six months, at the age of 59 years.

When in 1915 the town of Blenheim contracted for Hydro power, Mr. Knight was unanimously elected to the newly formed Blenheim Public Utilities Commission and became its chairman. Since then he was returned to office by acclamation each time, and with the exception of two years, was chairman during the whole period.

As he was unable to attend the Commission's annual meeting at the beginning of this year, it was held at his home, and he was again given the chairmanship, which he held until his death.



*E. W. (Doc) Knight*

Mr. Knight was of Irish descent, born on a farm north of Blenheim. He received his education in Blenheim and there became prominent in business and community activities, being one of the most highly respected men in the town. He is survived by one son, two daughters and three grand-children, and also one sister and two brothers.

# Incidents During Early Days of Hydro

**By T. J. Hannigan, Secretary, Ontario Municipal Electric Association**

*(From an address to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Ottawa, June 28, 1934).*

*Space does not permit the publication of Mr. Hannigan's entire address, but he said, in part, as follows;*

I HAVE been asked to give a brief sketch of some of the incidents leading to the organization of what is commonly called the Hydro System of Ontario, but which, to those who are familiar with the early history of it, means infinitely more than that.

It means the outgrowth and the progress of a great system of Municipal Ownership, conceived by men of vision and wrought out by those who, by bitter experience, realized the inadequacy of the systems then in use, to give to the people of the municipalities an ample supply of power at a reasonable price, in order that they might live and prosper and work out their appointed destiny, a free and independent people, with faith in their own ability to manage their own affairs, without paying tribute to Private Interests, for what they realized was going to become one of the great necessities of life—cheap Hydro Electric Energy.

In view of the various Hydro addresses you have heard at this Convention, I feel that anything I may say will be confined to a few rambling remarks about some of the happenings in the early days and how this movement originated, because, strange as it may seem to those of us who are getting along in years, there are people in the Province of Ontario that are of the opinion that Hydro is something we always had with us. There are people who cannot remember back past the beginning of the automobile age, and those who can remember or who take the trouble to remember about the early days of Hydro are not nearly as many as one might imagine.

True, there are many men here to-night who took a part in the early movement, and in the laying of the foundation stones and for one reason or another passed away from the work, to come back again in later years. They remember, but a great many others who were associated with the movement in the early days are not with us any longer. Some of them have gone to their eternal reward and others have turned their endeavours to other lines which are, perhaps, more profitable, if you count it in dollars and cents.

In the year 1900, the City of Toronto, through its Board of Trade, conceived the idea of bringing power from Niagara Falls, as a municipal undertaking. They appointed a committee; they investigated; they made a report. But that was about as far as it went because one municipality did not seem of sufficient importance to grant it the right to carry on this work. But if they did not do anything else, they created in the

minds of other people throughout the length and breadth of Ontario, and particularly Western Ontario, the germ of an idea which grew and expanded until it culminated in a meeting of the Board of Trade of the County of Waterloo. Power was being developed at Niagara, true, but it was being developed by privately owned companies and some of the men from Western Ontario had gone down and interviewed the companies to ask if they would not consider the building of a transmission line to serve some four or five or a half dozen municipalities which would be willing to provide their own distribution systems and pay so much for the power. The answer was: If you want the power, come to where it is. The privately owned companies felt that they could secure a ready market for all the available power, right close to their plants without going into the investment of large sums of money for the construction of transmission lines, power stations and so on.

At that time there was a man living in the little village of St. Jacobs, a man by the name of E. W. B. Snider, who enjoyed the confidence of his fellow citizens and the people throughout his district to a very, very marked degree. The Sniders were one of the pioneer families of that great country of Waterloo and he had a considerable connection—many relatives and many friends associated in business with him.

But when Mr. Snider introduced the suggestion at a meeting of the Waterloo Board of Trade in 1902, that a number of the municipalities go in together in what we might call a municipal undertaking to bring power from Niagara to be distributed in that area, the kindest thing that could be said was that his friends looked at him very coldly.

However, they were an adventurous people and there was a reason why. Some of them felt that the matter was worth looking into, so they decided to appoint a committee. One man after another was asked to become a member of that committee and they declined until when the committee was finally appointed, it was a committee of one—the late D. B. Detweiler of Berlin. He, like E. W. B. Snider, was a man who had considerable vision and men with vision have never been more than a very short crop in this or any other country. Some men can see up to the week before last. Some few can see up to the night before last and a still smaller number can see up to this evening, but as you go on up, they become fewer and fewer.

Some men can see until tomorrow and know what is going to take place tomorrow. Some look into next week; some, into next month; but when you get on, the men who can see into the future and see a vision that will show our grassy meadows and plains of the present time turned into growing cities with great populations in the future, cities that are great hives of industry, land that now has no railways or roads built up as certain parts of the Province of Ontario are to-day—they are the men of vision, the kind of men that make a province or a country or a nation great. These men had the vision and Dan. Detweiler was the torch-bearer, the man who went out to carry the light to the dark places, and the man, so imbued with

sincerity of purpose and desire to help his fellow men that he impressed all those that he came in contact with.

I do not know how many places he went to because, remember, this was before the automobile age. That was what we might call "the bicycle age". He used to ride a bicycle and went out the next morning after the meeting and struck off to the neighbouring villages and towns and cities. He interviewed Guelph, Galt and Waterloo, Preston, Hespeler, Brantford, Stratford and London, on his own time and at his own expense and his story was so impressive and the earnestness of the man so apparent that that long trip secured a great many followers who were willing to carry on with him and play the game. "And the seed fell upon good ground and it grew and flourished."

Guelph was one of the first places to join whole-heartedly and thoroughly in the scheme. It made a wonderful combination—the Germans and Dutch of Waterloo and the Scotch and the Irish and English in and about the City of Guelph. Guelph had at that time gone a little further along the line of public ownership than any other place in Canada. They owned their own electric light and gas plant, and their own street railway system. They had built and leased fifteen miles of steam railway to the C.P.R. for 99 years, and had proven to their own satisfaction that they were capable and competent to handle their own business and own affairs, just as well as a private company could do it for them and put the difference in the pockets of their people.

They did not go into those businesses because they wanted to go into them. They bought the street railway to get back a franchise given in early years to a private company, a charter just as complete as the old Hudson's Bay Company's where, after putting in everything they could think of, they added these words "and everything else in, on, or about the premises."

At the time Guelph took over the lighting system, before there was any thought of Hydro, they took it over in order to save the people money. They had cut the price down very considerably and they thought, by going in with a number of other municipalities they might do still better.

The County of Waterloo had a different reason. That district had been settled, as I said, with Pennsylvania Dutch and Germans—people to whom community effort was like a religion, people believed in doing things for the community rather than for private greed and gain and they had come into that district—beautiful, fertile land and as fine farmers as ever attempted to grow a crop outdoors anywhere in the world. They had settled down around the little streams, the little waterfalls, throughout this country. They had built dams and put in waterwheels and erected mills to grind the grain to feed themselves, their families and their stock. At one time there were a hundred and ten of these little water powers developed in the County of Waterloo and they did not belong to the individual taking tithes from his neighbours—they belonged to the community where they were helping one another. They felt that if they could do that thing in a small way and help out three or four

families here, over there and in the other places, by a lot of people joining together, there was very little that they could not accomplish along the line of co-operative effort.

That is the picture of the foundation. They did not know how to get going; they did not know how to finance it, but they had this remarkable vision and this sincerity of purpose which was an inspiration to the people in the other municiaplities to furnish them with the sinews of war. In the town of Berlin—and they are just as keen for a Dollar as the Scotch people in Guelph and that is going some!—they decided to investigate and get a number of public spirited citizens to contribute so they would get an engineer's report. They contributed, altogether, the magnificent some of $45.00, in two-dollar and one-dollar bills. They asked an eminent engineer what he thought about the thing and what he could do about looking into it and pronouncing on the feasibility of the project. That engineer was C. H. Mitchell of Toronto, now General C. H. Mitchell, Dean of the Faculty of Applied Science of the University of Toronto.

He agreed that he would go into the thing and that he would prepare a report that he would submit to the people without one single cent of cost, over and above his expenses. Times have changed!

He prepared that report and seven municipalities joined together and raised a sufficient sum of money to carry on still further. They went down to the government and asked that a committee be appointed to investigate along the lines that were suggested and prepare a report on the feasibility and practicability of transmitting power from Niagara Falls to serve that area, showing the cost of constructing the line, at what rate the people might be served and how the cost would be apportioned. There was some hesitation, because, as I said, they did not know just what they wanted.

I want to say this: There has never been a time in the history of this or any other country when in time of stress or need of the people that some one has not arisen to lead them out of the wilderness and overcome the obstacles that confronted them and do away with their trials and tribulations and inspire them so they will go out and do what we might call the impossible things.

At that time there was a young man living in the City of London, a man who had been elected Mayor of his town and had been elected a member of the Legislature of the Province of Ontario, a man whose birthplace was the County of Waterloo. These people knew this man. He was one of their own people and they have as much love for their own people as Scotch people have for those they call "their ain folk". They went to him and talked it over and got his support and he was the man of fire, the man of genius, the driving force and I venture to say, if it had not been for that man, our late Chief, the late Sir Adam Beck, the Hydro might well have died in its infancy, because he inspired other men who had not taken an interest in the movement. If he had lived a few centuries ago, he would have been a Crusader. He was the kind of man who could get out and raise armies and lead them on to victory. He

made people leave their comfortable firesides on stormy nights. He made them quarrel with their friends who believed in private ownership, because he so inspired them with the vision of the two men that started the movement and with his own fire and genius and honesty of purpose that they forgot all else and followed him, regardless of the cost or sacrifice to themselves.

There were men like the late P. W. Ellis of Toronto, one of the pioneers of the Hydro movement, a man connected with it from that time, more or less, who was one of the first Commissioners. When Adam Beck became the Chairman, Mr. Ellis was connected with Hydro and the distribution of electricity in Toronto from that time until he died, and he left a record that was worth while.

J. W. Lyons of Guelph, a man who had practically retired, a man who had made up his mind that for the balance of his days he was going to enjoy a well-earned rest and the comfort of a man who had acquired enough money to take care of his needs for the balance of his life, was another. And yet J. W. Lyons left his home, night after night, journeyed all over the Province of Ontario—in weather, sickness and troubles—they didn't consider anything else except that Adam Beck was calling them to come out and help carry the Hydro by-laws somewhere.

Mayor Beck of Brampton was one of the early men—a man who is still with us. There are many others. T. L. Church and C. A. Maguire of Toronto, Sam Carter of Guelph, C. J. Halliday of Chesley, Tom MacFarland of London, all of whom I am glad to say, are still with us. There are so many of them that I hesitate to go on and name because one is going to overlook some, no matter how carefully one may go, but there were a great band of pioneers, the apostles of Hydro.

There was another man, a man whose picture I saw in the paper today, the Honourable W. D. Euler of Berlin. I have known Mr. Euler to go out on nights that were not fit for anyone, either man or beast, to be out and drive miles and miles through snow storms and over bad roads, in order to carry the message of Hydro to the people because Beck wanted him to do it.

And so the report was prepared and it was presented and a contract was entered into, tentatively, with the Ontario Power Company of Niagara Falls, a company owned by people of the United States, and built primarily to develop power on the Canadian side to transmit across to be used in New York State, because at that time they were sending a great deal of power over there. It was necessary that a certain amount of power be subscribed for before they could go on with it. I remember that our small city agreed to take 2,500 horsepower. We were using 700 horsepower at that time, or thereabouts, and that was about our limit.

When Adam Beck said he had no doubt in his mind that the thing would be a success from the very beginning, that we would not have to pay for any more horsepower than we actually used, he made one statement that made a great impression on all his hearers, and helped to give confidence to those who might at times have

been doubtful. It was as follows,—"We have engaged the best engineers we could get, men at the head of the different branches of their profession. We have engaged them solely because of their ability to do certain things; their political affiliations, their social connections, and their relationship to men of influence has had no bearing upon their being engaged by this Commission, and never shall have, as long as I am connected with it."

Another statement he made in later years, when going through some of the investigations, which sought to belittle his efforts, and criticise the results of his work, was "When Hydro is not good enough to stand the closest investigation, and the most rigid scrutiny, then it is not good enough for the people of Ontario."

I am going to read a news item, without giving the name of the paper that it appeared in. It was a certain paper in Western Ontario, June 6, 1909. That was some time ago. It was an editorial. It says: "Has the Honourable Adam Beck become a monomaniac on the power question? His wild and extravagant assertions have justified the suspicion, were it not that they were timed and calculated for election purposes. In a flight of imagination during a speech the other evening, he declared that every cottage, every house, ever home in this city will be lighted by electricity, that his power scheme would raise men's wages, give two-cent fares on the railways and banish the tenements from Ontario. The taxpayers" he went on to say, "would not pay one cent of the cost which would be borne entirely by the consumers of power.

"His newspaper organ lets its fancy soar even higher and pictures the housewife heating her flat irons by electricity. Why not her curling tongs, too, instead of sweltering before a hot stove on a summer's day? If all the Arabian Night's rhetoric of Mr. Beck and his associates is to be believed, Niagara's power is a gift of the fairies, and free as air and by and by the householders will merely have to touch the button and the Beck scheme will do the rest."

And the remarkable thing is that within three or four years after that time, all those things not only had come to pass but many other appliances that had not been even dreamed of before the advent of Hydro had been invented, manufactured and brought into daily use. It is just to remind you that there was a time when we did not have cheap power, when we did not have all these appliances and, perhaps, to remind you that some men gave a lot of their lives and a lot of their energy and what little ability they may have had to something without any hope of reward, when they knew that they were being criticized by their friends, when they knew it was interfering with their businesses. And they did this for two reasons: One, was the inspiration of that great leader; and, the other was their desire to do something for their fellow citizens, more than the accumulation of wealth.

We have had our ups and downs. We have had our criticism; we have had our good times and our bad times. and constructive criticism is one of the best things the Hydro system or any other system could have, because the people who tell you, "Yes, you are

going along right; you are always right. You do not make any mistakes" — they are not your best friends. Your best friends are those who have the courage to come to you and say, "Don't you think it would be well to go slowly at this time? Why not give this matter a little more consideration?" or, if they know you are going absolutely wrong, to come and put their hand on your shoulder and steer you off on another course. But so long as we have courage in ourselves, so long as we continue to have faith in one another, we can carry along right down to the end of the road which may not be long for some of us. And I have felt, in connection with the years I have spent with Hydro, that when the time comes that my friends gather around to look at me for the last time and they carry me out in the brass handled box, if they can say this one thing in the words of Paul: "He has fought the good fight, he has kept the faith", that will be the greatest tribute I could imagine.

July 13th, 1934.

To The Staff,
Hydro-Electric Power Commission
of Ontario

It is with regret that I sever the pleasant and harmonious associations that have existed with you for so many years.

I take this opportunity of thanking you most heartily for your loyal support and excellent co-operation in carrying out in the past the many duties involved in the administration of the affairs of the Commission.

Yours sincerely,

T. J. Gaby

*Listowel P.U.C. Hydro substation and waterworks plant. Peony blooms in June, planted and cared for under supervision of R. B. Hanna, Supt.*

# Insulator Ties

**By R. E. Jones, Distribution Section, Electrical Engineering Dept., H.E.P.C. of Ont.**

*(Presented to Association of Municipal Electrical Utilities at Ottawa, June 29, 1934.)*

As with many items in a distribution system a tie in itself appears to be a thing of minor importance. However when consideration is given to the large number used and the possibility of serious trouble from a single failure, it will be evident that this item warrants careful investigation.

A tie must hold the conductor firmly on the insulator and prevent movement of the conductor either vertically, laterally, or by slipping longitudinally. At the same time the tie must not be so rigid as to invite vibration trouble. Metal clamps have been made for this purpose but the design has been unsatisfactory.

For many years the standard insulator for power conductors had a side groove only, patterned after the telegraph insulator. With the small wires and short spans then in use, this insulator served its purpose satisfactorily. Later the use of larger conductors led to the design of the present insulator with top and side grooves.

On straight runs the conductor may be placed in the top groove and in this position it has vertical support independent of the tie wire. The latter is required only to prevent the conductor lifting off the insulator or slipping endways.

At angles the conductor is laid in the side groove and the tension in the line tends to hold it in place.

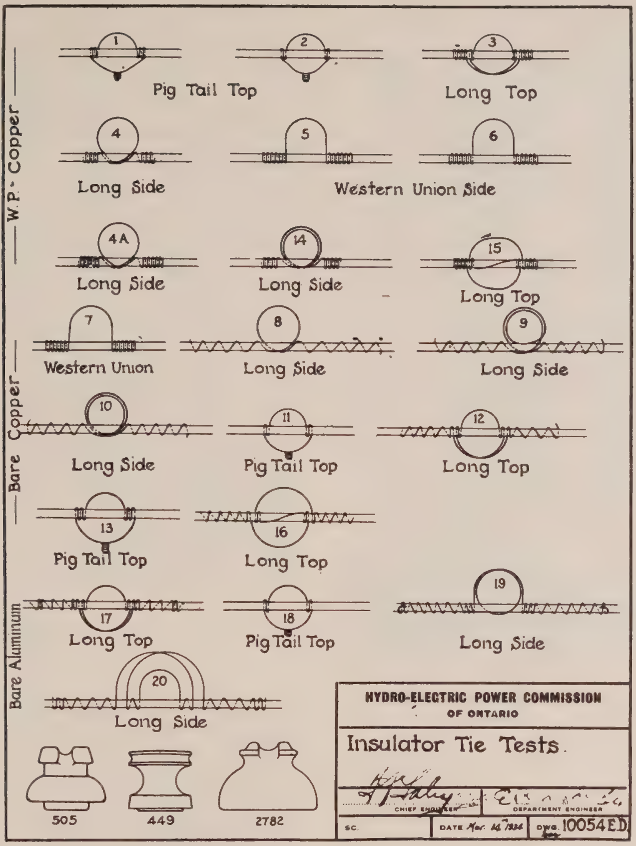
Ties are designed from experiment and test rather than from theory due to the many variables in their make-up. In a recent investigation some five hundred ties were made and tested in the Commission's Laboratory.

To make these tests a 12 foot length of line conductor was erected in a horizontal position and tension similar to field conditions was applied. An insulator on a pin was held against the conductor and the tie was then applied, two samples of each design being made.

With the conductor still in position a test was made on one sample of each tie to determine its ability to resist movement of the conductor vertically from the insulator. After placing a wooden support beneath the conductor on each side of the insulator, a dynamometer was placed on the insulator pin and load was applied. This is designated here as the "Vertical Test".

The remaining samples were separated, with a short length of conductor on each insulator. Each was placed in a testing machine and load was applied at right angles to the pin and longitudinally in the direction of the line wire to determine the resistance of the tie to slipping. In the tables this is designated as the "End Test".

For top ties a standard low voltage top tie insulator was used. For side ties a secondary rack spool was selected as giving the most severe conditions for a tie. These tests were




*Insulator Tie Diagrams*

made on copper line conductor of No. 6, No. 4, No. 2, No. 0 and No. 0000 A.W.G., both bare and double braid weatherproof. The No. 6, No. 4 and No. 2 were hard drawn and the remainder medium hard. No. 2 and larger were stranded. Tie wires were No. 8, No. 6 and No. 4, bare and weatherproof. The first two in both hard and medium hard and the latter in medium hard only. The tie wire in each case had the same covering as the line conductor.

Tests were also made for aluminum line conductor of No. 4 steel reinforced with No. 6 aluminum tie wire and .05 by .30 in. flat armor tape.

Pliers were used in making the copper ties unless otherwise noted, but in no case with the aluminum.

Due to the limit of strength of the pin and of some of the conductors some tests were not carried to the point of failure. In the tables these are designated by a plus (+) sign. In the vertical tests where the conductor pulled away from the insulator without definitely failing, the separation is noted under "Remarks".

The following ties were tested, the

*Testing Insulator Ties, Vertical*

nomenclature, which is in general use being more descriptive than technical.

*Weatherproof Conductors*

1. Pig tail top tie with two turns around line conductor.

2. Pig tail top tie with one turn around conductor.

3. Long top tie.

4. Long side tie using four turns of tail around conductor.

4A. Same as 4 but with six turns around conductor.

5. Western Union side tie with tie wire coming over line conductor. With this tie, in time as tie stretches, there is a tendency for the conductor to roll down the insulator and thus tighten the tie. The reverse action is apt to take place with the old form of this tie.

6. Same as 5 but with tie wire passed beneath the conductor.

14. Same as 4 but with third pass of tie wire over the line conductor.

15. Similar to 4 but with tie passing around the conductor in the groove.

*Bare Conductors*

7. Western Union side tie with tie wire passing over conductor.

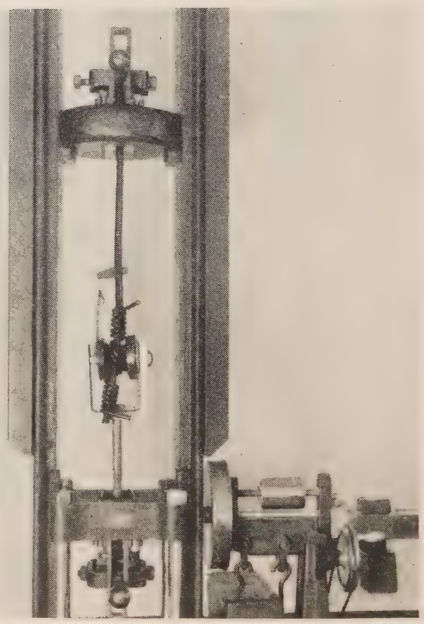
8. Long side tie similar to 4 but with longer twist to tails of tie.

9. Standard side tie as used by H.E.P.C. This is similar to 8 with addition of a turn of the tie wire around the insulator only.

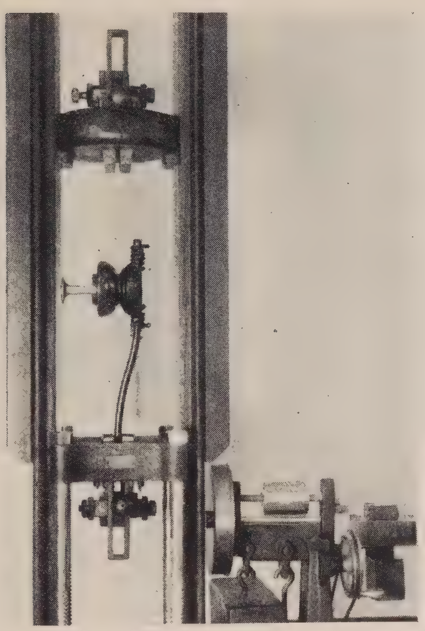
10. Similar to 9 but with turn of tie wire around conductor as well as around the insulator.

11. Pig tail top tie with one turn of tie wire around conductor.

12. Long top tie.



*Testing Insulator Ties, End Test, Side Ties*



*Testing Insulator Ties, End Test, Top Ties.*

13. Similar to 11 but with two turns of tie around conductor.

16. Similar to 12 but with tie passing around conductor in the insulator groove.

*Aluminum Conductors (Bare)*

17. Long top tie

18. Pig tail top tie

19. Old long side tie

20. Revised long side tie

The detailed results of the tests are given in Table A.

After eliminating the ties which could not be made satisfactorily, the results of the end tests, which gave lower results than the vertical tests, were summarized in Table B.

The following points were noted during the course of the tests.

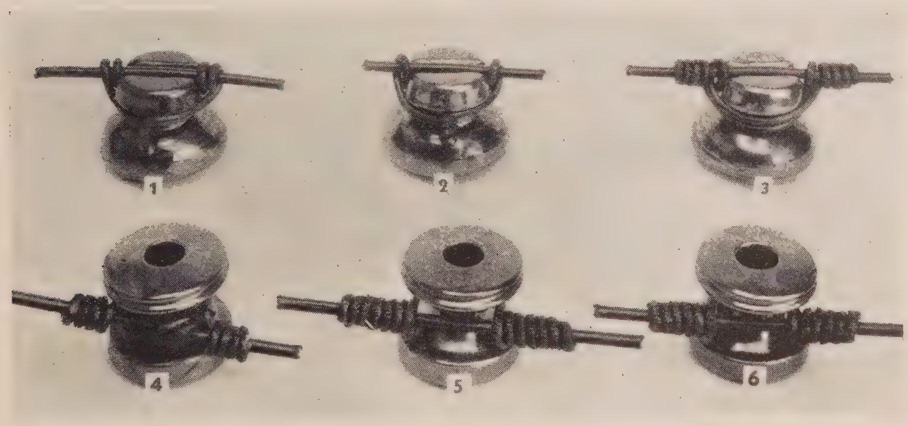
No. 4 tie wire is not sufficiently flexible for satisfactory use in making ties.

Ties 15 and 16 allow the conductor to rest on the tie wire in the groove, providing a point at which vibration trouble may originate.

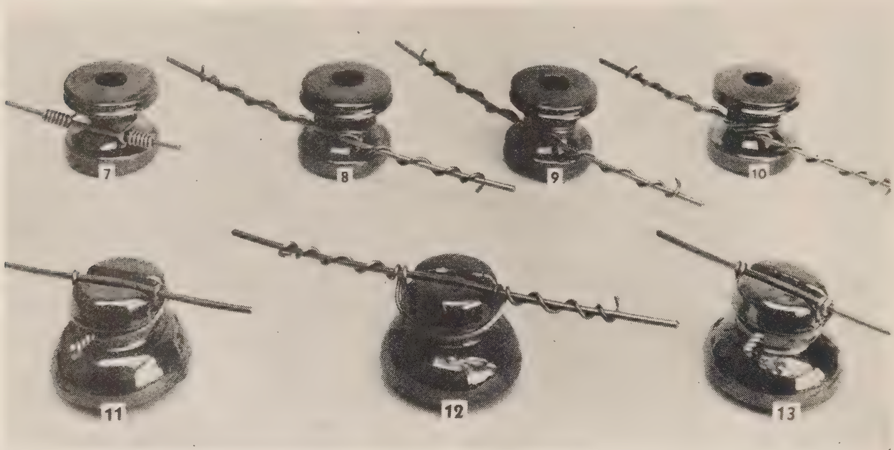
Tie 14 is not easy to make where insulator is in a rack. Also the groove of the insulator may not be large enough to accommodate the tie, even with the smaller conductors.

For ties on copper conductors pliers must be used to obtain the best results.

Experience has shown that especially with higher stringing tensions vibration may break the strands of




*Insulator Ties.*

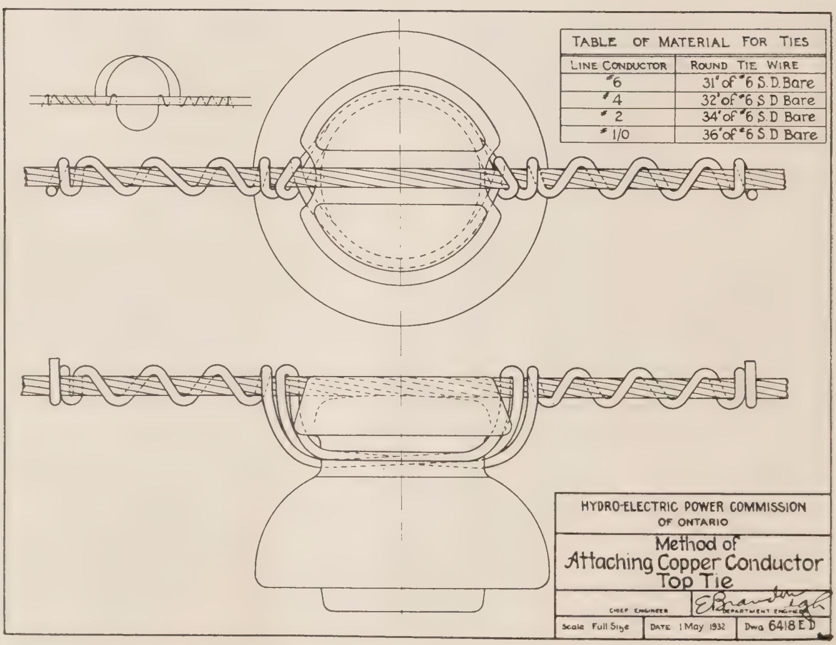



*Insulator Ties.*

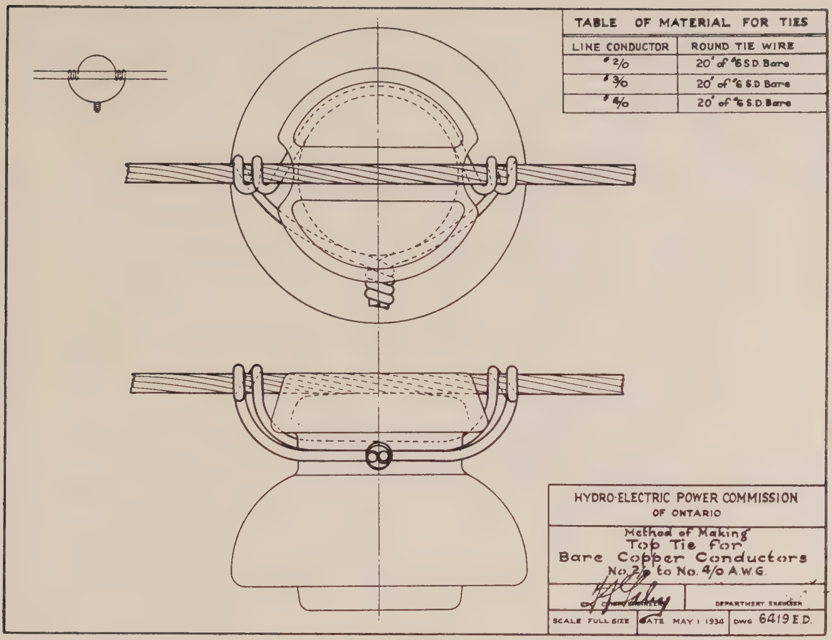
copper or aluminum conductors at the insulator or other point of support.

This vibration is usually caused by a light breeze not heavy wind. It is seldom present in weatherproof conductors due to the damping effect of the covering.

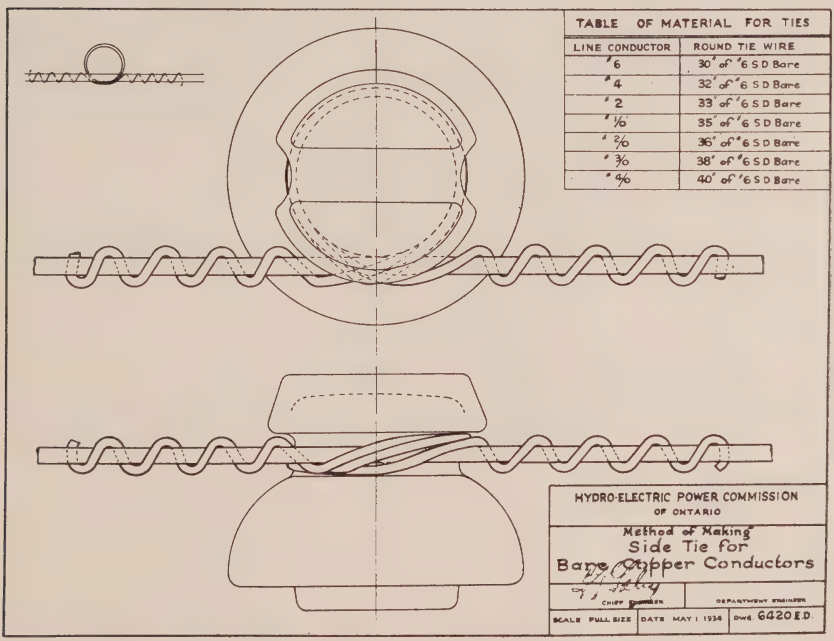
To check up the practice as regards ties and insulators, tests were carried out by the Aluminum Company of



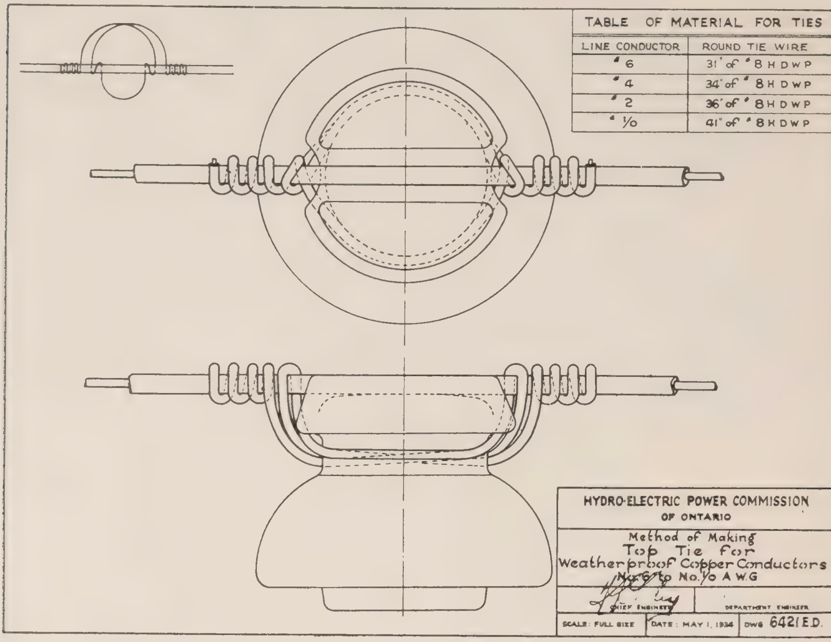

*Top Tie for Bare Copper Conductors, No. 6 to No. 0.*



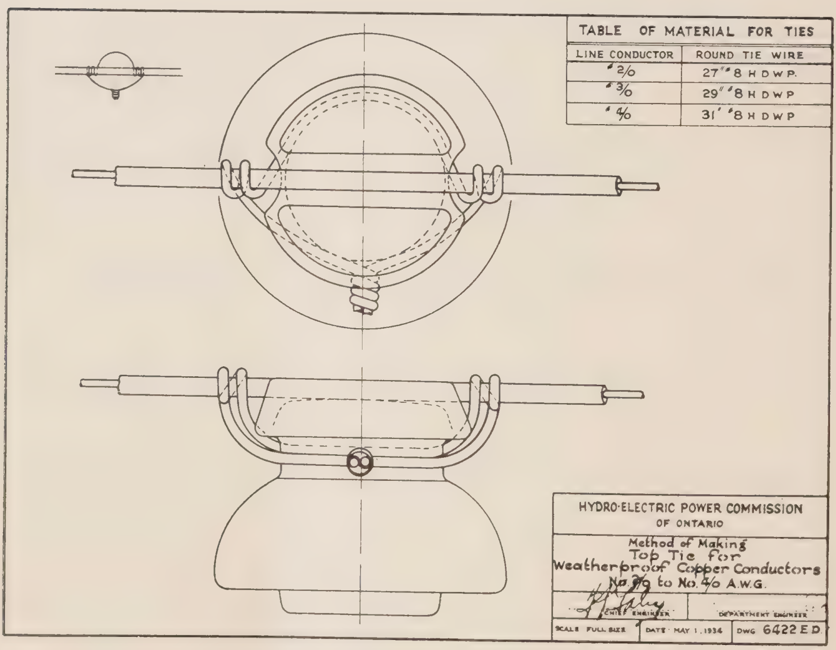

*Top Tie for Bare Copper Conductors, No. 00 to No. 0000.*



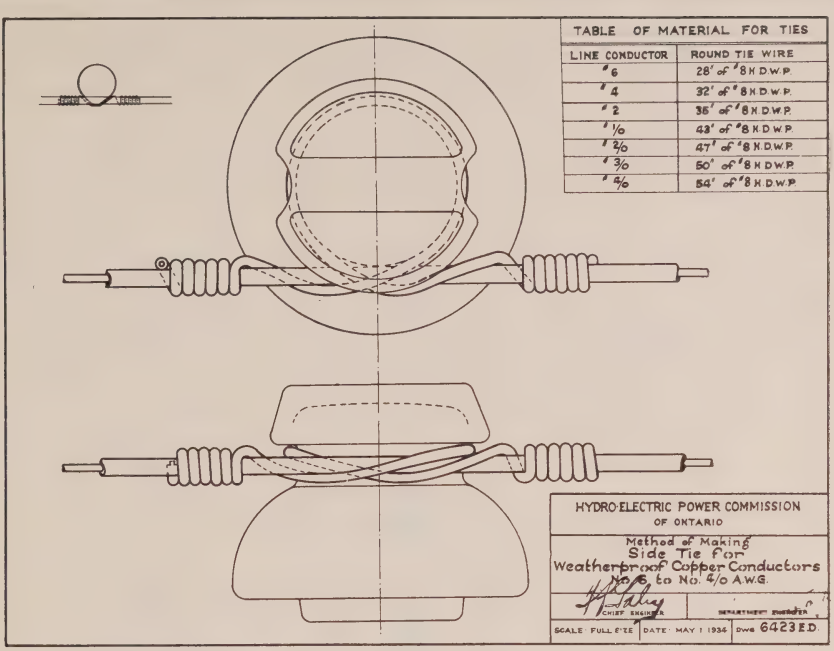

*Side Tie for Bare Copper Conductors, No. 6 to No. 0000.*



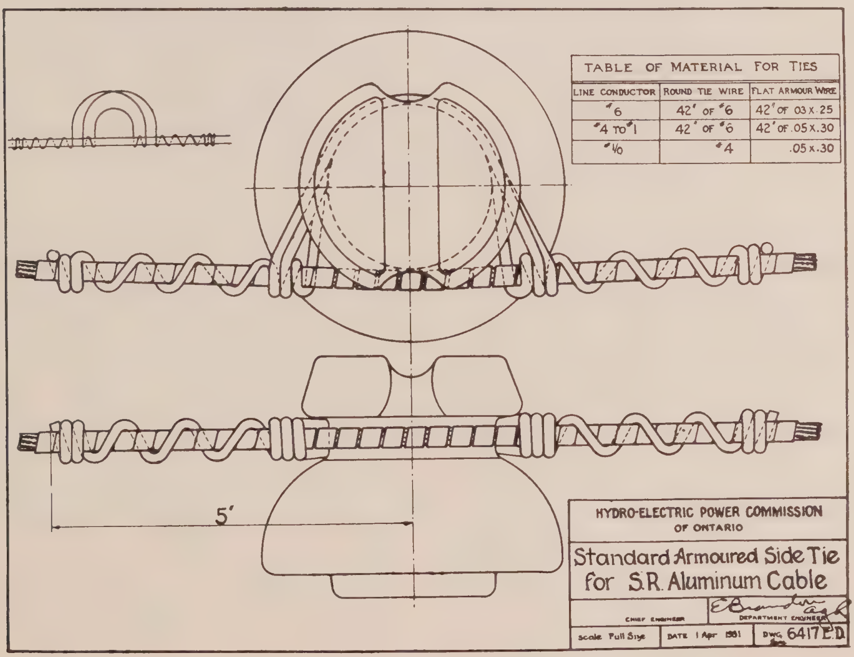

*Top Tie for Weatherproof Copper Conductors, No. 6 to No. 0*



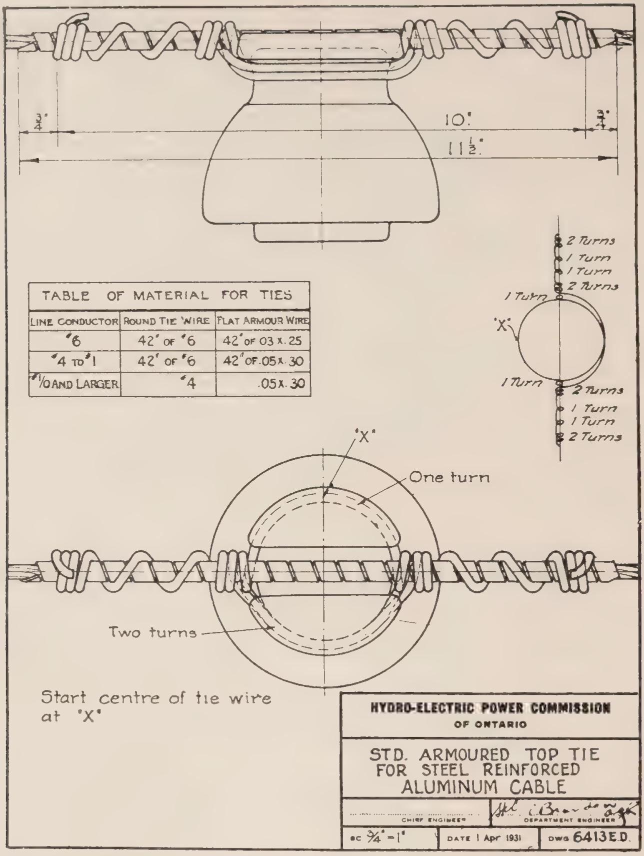

*Top Tie for Weatherproof Copper Conductors, No. 00 to No. 0000.*




*Side Tie for Weatherproof Copper Conductors No. 6 to No. 0000.*




*Side Tie for Aluminum Conductors, Steel Reinforced.*




*Top Tie for Aluminum Conductors, Steel Reinforced.*

America at its Vibration Laboratory at Massena.

A cable consisting of seven No. 4 a.c.s.r. was so arranged that it fanned out at one end to seven insulators with test ties. At the other end was the vibrating mechanism whereby the 120 foot span was vibrated at 1350 cycles per minute giving an amplitude of 1¾ inches. The cable was stressed to 70 per cent. of its ultimate strength.

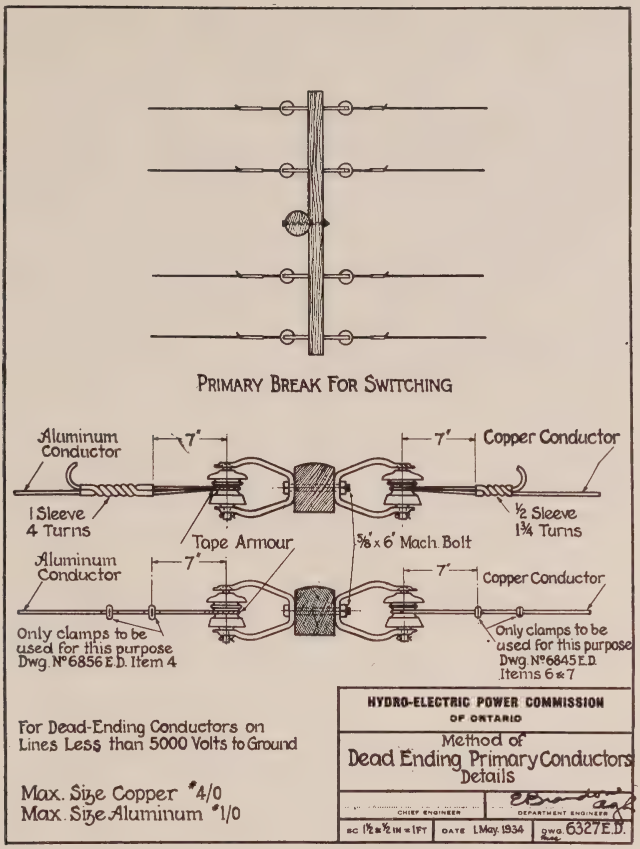
A ratio between the life of a conductor in these tests and in the field cannot be ascertained as the tests were designed only to give the relative value of the various ties.

Various insulators and ties were tested, the insulators having different grooves. Ties were both side and top types each of various forms. The tests were carried on as far as 100,000,000 cycles in some cases.

From these tests it was shown that armor rods give the best protection from vibration. However in the smaller conductors they are somewhat awkward to install.

The standard top tie with single tape armor should give satisfactory service.

The side tie should be used at angles only and should be revised so that the




*Dead Ending Conductors with Clevis and Insulator.*

conductor will not rest on a tie-wire in the groove of the insulator.

A good insulator should have a curved groove with a flat bottom, with ends of groove bell-mouthed.

Later similar tests were made on No. 6 hard drawn bare copper wire. Side ties were used both in tangents and on angles.

The results showed in favor of the H.E.P.C. long side tie.

From all of above tests the following ties are recommended for use on distribution lines:—

*Bare Copper Conductors:—*

Top Tie—No. 6 to No. 0—Tie 12—No. 6 s.d. bare wire

No. 00 to No. 0000—Tie 13—No. 6 s.d. bare wire.

Side Tie—No. 6 to No. 0000—Tie 10—No. 6 s.d. bare wire.

*Weatherproof Copper Conductors*

Top Tie—No. 6 to No. 0—Tie 3—No. 8 h.d.w.p. tie wire

No. 00 to No. 0000—Tie 1—No. 8 h.d.w.p. tie wire.

Side Tie—No. 6 to No 0000—Tie 4A—No. 8 h.d.w.p. tie wire.

*Aluminum Conductors*

Top Tie—Long Tie—No. 6 tie wire and armor tape.

Side Tie—Revised side tie—No. 6 tie wire and armor tape.

The dead-ending of conductors on pins has not been considered. With this method of terminating conductors it is difficult to divide the load between the two pins. For this reason the use of a primary clevis and insulator is recommended for voltages not exceeding 5000 to ground. Medium hard drawn copper may be served at this point. Hard drawn copper and steel reinforced aluminum must be attached with a twisted sleeve or suitable clamps. The latter are readily installed and may be removed to adjust slack in the conductors.

Asknowledgement is made to Mr. G. W. Stickley who conducted the tests at Massena, Mr. H. B. Tett, who assisted in making the copper ties, and the Commission Laboratory staff who tested the latter ties.

TABLE A.

DETAILED RESULTS OF TESTS

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 6 h.d. bare copper wire* | | | | |
| No. 8 s.d. | 449 | W.U. (7) | 255 | Kink in Line | 560+ | Kink in Line |
| No. 6 s.d. | 449 | W.U. (7) | 235 | Kink in Line | 550+ | Kink in Line |
| No. 8 s.d. | 449 | Long (8) | 80 | | 390+ | |
| No. 6 s.d. | 449 | Long (8) | 130 | | 500+ | |
| No. 8 s.d. | 449 | Long (9) | 90 | | 460 | |
| No. 6 s.d. | 449 | Long (9) | 250 | | 500+ | |
| No. 8 s.d. | 449 | Long (10) | 230 | | 700+ | |
| No. 6 s.d. | 449 | Long (10 | 475 | | 600+ | |
| No. 8 s.d. | 505 | Pigtail (11) | 15 | | 600+ | 1/8 in. |
| No. 6 s.d. | 505 | Pigtail (11) | 20 | | 640+ | |
| No. 8 s.d. | 505 | Pigtail (13) | 10 | | 550+ | 1/16 in. |
| No. 6 s.d. | 505 | Pigtail (13) | 25 | | 570+ | |
| No. 8 s.d. | 505 | Long (12) | 50 | | 600+ | |
| No. 6 s.d. | 505 | Long (12) | 140 | | 620+ | 1/8 in. |
| No. 8 s.d. | 505 | Long (16) | 210 | Line rides on tie | 530 | Line rides on tie |

TABLE A. (*Cont'd.*)
Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 4 h d. bare copper wire* | | | | |
| No. 8 s.d. | 449 | W.U. (7) | 300 | Kink in Line | 1050 | Kink in Line |
| No. 6 s.d. | 449 | W.U. (7) | 340 | Kink in Line | 1000+ | Kink in Line |
| No. 8 s.d. | 449 | Long (8) | 160 | | 440 | |
| No. 6 s.d. | 449 | Long (8) | 270 | | 650+ | |
| No. 4 s.d. | 449 | Long (8) | 465 | | 650+ | |
| No. 8 s.d. | 449 | Long (9) | 140 | | 450 | |
| No. 6 s.d. | 449 | Long (9) | 305 | | 650+ | |
| No. 4 s.d. | 449 | Long (9) | 145 | | 890 | |
| No. 8 s.d. | 449 | Long (10) | 40 | | 1000+ | |
| No. 6 s.d. | 449 | Long (10) | 330 | | 1000+ | |
| No. 4 s.d. | 449 | Long (10) | 570 | | 1000+ | |
| No. 8 s.d. | 505 | Pigtail (11) | 5 | | 1000+ | 1/4 in. |
| No. 6 s.d. | 505 | Pigtail (11) | 30 | | 1000+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (11) | 35 | | 1000+ | |
| No. 8 s.d. | 505 | Pigtail (13) | 30 | | 1140 | |
| No. 6 s.d. | 505 | Pigtail (13) | 20 | | 1000+ | 1/8 in. |
| No. 8 s.d. | 505 | Long (12) | 40 | | 1000+ | 1/8 in. |
| No. 6 s.d. | 505 | Long (12) | 45 | | 1000+ | 1/8 in. |
| No. 4 s.d. | 505 | Long (12) | 190 | | 1000+ | 1/8 in. |
| No. 8 s.d. | 505 | Long (16) | 85 | Line rides on tie | 790 | Line rides on tie |
| | | *No. 2 h.d. bare copper strand* | | | | |
| No. 8 s.d. | 449 | W.U. (7) | 260 | | 940 | |
| No. 6 s.d. | 449 | W.U. (7) | 420 | | 1220+ | |
| No. 8 s.d. | 449 | Long (8) | 180 | | 950 | Tie broke |
| No. 6 s.d. | 449 | Long (8) | 410 | | 1000+ | |
| No. 4 s.d. | 449 | Long (8) | 290 | | 1000+ | |
| No. 8 s.d. | 449 | Long (9) | 215 | | 500 | |
| No. 6 s.d. | 449 | Long (9) | 420 | | 1000 | |
| No. 4 s.d. | 449 | Long (9) | 500 | | 1000+ | |
| No. 8 s.d. | 449 | Long (10) | 245 | | 1000+ | |
| No. 6 s.d. | 449 | Long (10) | 550 | | 1000+ | |
| No. 4 s.d. | 449 | Long (10) | 980 | | 1000+ | |

TABLE A. (*Cont'd.*)

Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 2 h.d. bare copper strand (cont'd.)* | | | | |
| No. 8 s.d. | 505 | Pigtail (11) | 35 | | 900+ | 1/4 in. |
| No. 6 s.d. | 505 | Pigtail (11) | 20 | | 1000+ | |
| No. 4 s.d. | 505 | Pigtail (11) | 35 | | 1000+ | |
| No. 8 s.d. | 505 | Pigtail (13) | 60 | | 1200 | |
| No. 6 s.d. | 505 | Pigtail (13) | 40 | | 1200+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (13) | 45 | | 1200+ | |
| No. 8 s.d. | 505 | Long (12) | 130 | | 1000+ | 1/4 in. |
| No. 6 s.d. | 505 | Long (12) | 370 | | 1000+ | 1/8 in. |
| No. 4 s.d. | 505 | Long (12) | 510 | | 1000+ | |
| | | *No. 0 m.h.d. bare copper strand* | | | | |
| No. 8 s.d. | 449 | W.U. (7) | 235 | | 900 | |
| No. 6 s.d. | 449 | W.U. (7) | 445 | | 900 | |
| No. 4 s.d. | 449 | W.U. (7) | 435 | | 1300+ | |
| No. 8 s.d. | 449 | Long (8) | 80 | | 410 | |
| No. 6 s.d. | 449 | Long (8) | 290 | | 850 | |
| No. 4 s.d. | 449 | Long (8) | 200 | | 1200+ | |
| No. 8 s.d. | 449 | Long (9) | 50 | | 490 | |
| No. 6 s.d. | 449 | Long (9) | 160 | | 710 | |
| No. 4 s.d. | 449 | Long (9) | 200 | | 1120 | |
| No. 8 s.d. | 449 | Long (10) | 160 | | 1200+ | |
| No. 6 s.d. | 449 | Long (10) | 580 | | 1250+ | |
| No. 4 s.d. | 449 | Long (10) | 625 | | 1220+ | |
| No. 8 s.d. | 505 | Pigtail (11) | 50 | | 1200+ | 3/8 in. |
| No. 6 s.d. | 505 | Pigtail (11) | 45 | | 1200+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (11) | 80 | | 1200+ | 1/8 in. |
| No. 8 s.d. | 505 | Pigtail (13) | 75 | | 1200 | |
| No. 6 s.d. | 505 | Pigtail (13) | 55 | | 1200+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (13) | 40 | | 1200+ | 1/4 in. |
| No. 8 s.d. | 505 | Long (12) | 85 | | 1200 | |
| No. 6 s.d. | 505 | Long (12) | 290 | | 1230+ | 1/8 in. |
| No. 4 s.d. | 505 | Long (12) | 420 | | 1200+ | 1/8 in. |

TABLE A. (*Cont'd.*)
DETAILED RESULTS OF TESTS

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 0000 m.h.d. bare copper strand* | | | | |
| No. 6 s.d. | 449 | W.U. (7) | 185 | | 640 | Tie Wire broke |
| No. 8 s.d. | 449 | Long (8) | 70 | | 1000 | |
| No. 6 s.d. | 449 | Long (8) | 235 | | 1340 | |
| No. 4 s.d. | 449 | Long (8) | 350 | | 1000+ | |
| No. 8 s.d. | 449 | Long (9) | 255 | | 640 | |
| No. 6 s.d. | 449 | Long (9) | 210 | | 730 | |
| No. 4 s.d | 449 | Long (9) | 170 | | 570 | |
| No. 8 s.d. | 449 | Long (10) | 200 | | 1000+ | |
| No. 6 s.d. | 449 | Long (10) | 465 | | 1500+ | |
| No. 4 s.d. | 449 | Long (10) | 470 | | 1000+ | |
| No. 8 s.d. | 505 | Pigtail (11) | 40 | | 1000+ | 1/4 in. |
| No. 6 s.d. | 505 | Pigtail (11) | 25 | | 1310+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (11) | 75 | | 1360+ | 1/8 in. |
| No. 8 s.d. | 505 | Pigtail (13) | 80 | | 1300 | |
| No. 6 s.d. | 505 | Pigtail (13) | 300 | | 1350+ | 1/8 in. |
| No. 4 s.d. | 505 | Pigtail (13) | 80 | | 1440+ | 1/4 in. |
| No. 8 s.d. | 505 | Long (12) | 40 | | 820 | |
| No. 6 s.d. | 505 | Long (12) | 110 | | 1300 | |
| No. 4 s.d. | 505 | Long (12) | 145 | | 1440 | |
| | | *No. 6 h.d. d.b. w.p. copper wire* | | | | |
| No. 8 h.d. | 449 | W.U. (5) | 154 | No pliers | 550 | No pliers |
| No. 8 h.d. | 449 | W.U. (5) | 410 | | 840 | |
| No. 8 m.h.d. | 449 | W.U. (5) | 74 | No pliers | 650 | No pliers |
| No. 8 m.h.d. | 449 | W.U. (5) | 275 | | 690 | |
| No. 6 h.d. | 449 | W.U. (5) | 75 | No pliers | 650 | No pliers |
| No. 6 h.d. | 449 | W.U. (5) | 470 | | 840 | |
| No. 6 m.h.d. | 449 | W.U. (5) | 100 | No pliers | 450 | No pliers |
| No. 6 m.h.d. | 449 | W.U. (5) | 470 | | 930+ | |
| No. 8 h.d. | 449 | W.U. (6) | 70 | No pliers | 350 | No pliers |
| No. 8 h.d. | 449 | W.U. (6) | 480 | | 820 | |
| No. 6 h.d. | 449 | W.U. (6) | 100 | No pliers | 460 | No pliers |
| No. 6 h.d. | 449 | W.U. (6) | 570 | | 860+ | |
| No. 8 h.d. | 449 | Long (4) | 75 | No pliers | 350 | No pliers |
| No. 8 h.d. | 449 | Long (4) | 320 | | 650 | |

TABLE A. (*Cont'd.*)

Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | *No. 6 h.d. d.b. w.p. copper wire (cont'd.)* | | | | | |
| No. 8 m.h.d. | 449 | Long (4) | 45 | No pliers | 50 | No pliers |
| No. 8 m.h.d. | 449 | Long (4) | 255 | | 320 | |
| No. 6 h.d. | 449 | Long (4) | 85 | No pliers | 250 | No pliers |
| No. 6 h.d. | 449 | Long (4) | 250 | | 760 | |
| No. 6 m.h.d. | 449 | Long (4) | 55 | No pliers | 200 | No pliers |
| No. 6 m.h.d. | 449 | Long (4) | 375 | | 670 | |
| No. 8 h.d. | 449 | Long (4A) | 270 | No pliers | 360 | No pliers |
| No. 8 h.d. | 449 | Long (4A) | 355 | | 620 | |
| No. 6 h.d. | 449 | Long (4A) | 85 | No pliers | 190 | No pliers |
| No. 6 h.d. | 449 | Long (4A) | 365 | | 810 | |
| No. 8 h.d. | 449 | Long (14) | 190 | No pliers | 1000+ | No pliers |
| No. 8 h.d. | 449 | Long (14) | 750 | | 860+ | |
| No. 8 h.d. | 505 | Pigtail (2) | 75 | | 970+ | 1/2 in. |
| No. 8 m.h.d. | 505 | Pigtail (2) | 50 | | 800+ | 3/8 in. |
| No. 6 h.d. | 505 | Pigtail (2) | 100 | | 800+ | 1/4 in. |
| No. 6 m.h.d. | 505 | Pigtail (2) | 30 | | 700+ | 1/8 in. |
| No. 8 h.d. | 505 | Pigtail (1) | 135 | | 820+ | 1/8 in. |
| No. 8 m.h.d. | 505 | Pigtail (1) | 130 | | 820+ | 1/8 in. |
| No. 6 h.d. | 505 | Pigtail (1) | 190 | | 750+ | |
| No. 8 h.d. | 505 | Long (3) | 60 | No pliers | 700+ | 3/8 in. No pliers |
| No. 8 h.d. | 505 | Long (3) | 500+ | | 720+ | 1/8 in. |
| No. 8 m.h.d. | 505 | Long (3) | 55 | No pliers | 700+ | 3/8 in. No pliers |
| No. 8 m.h.d. | 505 | Long (3) | 490 | | 700+ | 1/8 in. |
| No. 6 h.d. | 505 | Long (3) | 110 | No pliers | 700+ | No pliers |
| No. 6 h.d. | 505 | Long (3) | 470 | | 700+ | 1/8 in. |
| No. 6 m.h.d. | 505 | Long (3) | 85 | No pliers | 700+ | 1/4 in. No pliers |
| No. 6 m.h.d. | 505 | Long (3) | 550 | | 700+ | 1/16 in. |
| No. 8 m.h.d. | 505 | Long-tie (15) | 550 | | 550 | |

TABLE A. *(Cont'd.)*
Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 4 h.d. d.b. w.p. copper wire* | | | | |
| No. 8 h.d. | 449 | W.U. (5) | 60 | No pliers | 440 | No pliers |
| No. 8 h.d. | 449 | W.U. (5) | 530 | | 670 | |
| No. 8 m.h.d. | 449 | W.U. (5) | 30 | No pliers | 490 | No pliers |
| No. 8 m.h.d. | 449 | W.U. (5) | 510 | | 800 | |
| No. 6 h.d. | 449 | W.U. (5) | 550 | | 680 | |
| No. 6 m.h.d. | 449 | W.U. (5) | 435 | | 1000+ | |
| No. 8 h.d. | 449 | W.U. (6) | 530 | | 670 | |
| No. 6 h.d. | 449 | W.U. (6) | 675 | | 1000+ | |
| No. 8 h.d. | 449 | Long (4) | 55 | No pliers | 490 | No pliers |
| No. 8 h.d. | 449 | Long (4) | 360 | | 650 | |
| No. 8 m.h.d. | 449 | Long (4) | 35 | No pliers | 250 | No pliers |
| No. 8 m.h.d. | 449 | Long (4) | 405 | | 600 | |
| No. 6 h.d. | 449 | Long (4) | 560 | | 825 | |
| No. 6 m.h.d. | 449 | Long (4) | 370 | | 770 | |
| No. 8 h.d. | 449 | Long (4A) | 430 | | 600 | |
| No. 6 h.d. | 449 | Long (4A) | 500 | | 910 | |
| No. 8 h.d. | 449 | Long (14) | 1205 | Tie broke | 1000+ | |
| No. 8 h.d. | 505 | Pigtail (2) | 80 | | 770+ | 1/8 in. |
| No. 8 m.h.d. | 505 | Pigtail (2) | 55 | | 720+ | 3/16 in. |
| No. 6 h.d. | 505 | Pigtail (2) | 30 | | 700+ | 1/16 in. |
| No. 6 m.h.d. | 505 | Pigtail (2) | 70 | | 720+ | 1/8 in. |
| No. 8 h.d. | 505 | Long (3) | 365 | | 700+ | 1/8 in. |
| No. 8 m.h.d. | 505 | Long (3) | 525+ | | 730+ | 1/8 in. |
| No. 6 h.d. | 505 | Long (3) | 500+ | | 720+ | 1/16 in. |
| No. 6 m.h.d. | 505 | Long (3) | 500+ | | 700+ | 1/16 in. |
| | | *No. 2 h.d. d.b. w.p. copper strand* | | | | |
| No. 8 h.d. | 449 | W.U. (5) | 210 | | 540 | |
| No. 8 m.h.d. | 449 | W.U. (5) | 200 | | 370 | |
| No. 6 h.d. | 449 | W.U. (5) | 320 | | 660 | |
| No. 6 m.h.d. | 449 | W.U. (5) | 280 | | 640 | |
| No. 4 m.h.d. | 449 | W.U. (5) | 405 | | 1020 | |
| No. 8 h.d. | 449 | Long (4) | 390 | | 300 | |
| No. 8 m.h.d. | 449 | Long (4) | 250 | | 290 | |
| No. 6 h.d. | 449 | Long (4) | 320 | | 650 | |

TABLE A. (*Cont'd.*)
Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | | *No. 2 h.d. d.b. w p. copper strand (cont'd.)* | | | | |
| No. 6 m.h.d. | 449 | Long (4) | 370 | | 510 | |
| No. 4 m.h.d. | 449 | Long (4) | 310 | | 950 | |
| No. 8 h.d. | 449 | Long (4A) | 440 | | 400 | |
| No. 6 h.d. | 449 | Long (4A) | 282 | | 580 | |
| No. 4 m.h.d. | 449 | Long (4A) | 420 | | 1020 | |
| No. 8 h.d. | 505 | Pigtail (2) | 75 | | 1400+ | 1/2 in. |
| No. 8 m.h.d. | 505 | Pigtail (2) | 70 | | 1400+ | 5/8 in. |
| No. 6 h.d. | 505 | Pigtail (2) | 100 | | 1400+ | 5/8 in. |
| No. 6 m.h.d. | 505 | Pigtail (2) | 55 | | 1500+ | 1/2 in. |
| No. 4 m.h.d. | 505 | Pigtail (2) | 40 | | 1500+ | 3/8 in. |
| No. 8 h.d. | 505 | Pigtail (1) | 120 | | 760 | |
| No. 8 m.h.d. | 505 | Pigtail (1) | 125 | | 720 | |
| No. 6 h.d. | 505 | Pigtail (1) | 75 | | 1000+ | 1/8 in. |
| No. 4 m.h.d. | 505 | Pigtail (1) | 65 | | 1000+ | 1/16 in |
| No. 8 h.d. | 505 | Long (3) | 500+ | | 1400+ | 3/8 in. |
| No. 8 m.h.d. | 505 | Long (3) | 560+ | | 1160 | |
| No. 6 h.d. | 505 | Long (3) | 360 | | 1400+ | 1/2 in. |
| No. 6 m.h.d. | 505 | Long (3) | 400 | | 1500+ | 1/2 in. |
| No. 4 m.h.d. | 505 | Long (3) | 660 | | 1500+ | 1/2 in. |
| | | *No. 0 m.h.d. d.b. w.p. copper strand* | | | | |
| No. 8 h.d. | 449 | W.U. (5) | 605 | | 490 | |
| No. 8 m.h.d. | 449 | W.U. (5) | 250 | | 900 | |
| No. 6 h.d. | 449 | W.U. (5) | 405 | | 1070 | |
| No. 6 m.h.d. | 449 | W.U. (5) | 320 | | 940 | |
| No. 4 m.h.d. | 449 | W.U. (5) | 510 | | 1240 | |
| No. 8 h.d. | 449 | Long (4) | 370 | | 400 | |
| No. 8 m.h.d. | 449 | Long (4) | 250 | | 320 | |
| No. 6 h.d. | 449 | Long (4) | 435 | | 660 | |
| No. 6 m.h.d. | 449 | Long (4) | 255 | | 480 | |
| No. 4 m.h.d. | 449 | Long (4) | 420 | | 840 | |
| No. 8 h.d. | 449 | Long (4A) | 610 | | 460 | |
| No. 6 h.d. | 449 | Long (4A) | 420 | | 610 | |
| No. 4 m.h.d. | 449 | Long (4A) | 370 | | 760 | |

TABLE A. (*Cont'd.*)
Detailed Results of Tests

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| *No. 0 m.h.d. d.b. w.p. copper strand (cont'd.)* | | | | | | |
| No. 8 h.d. | 505 | Pigtail (2) | 90 | | 1300 | |
| No. 8 m.h.d. | 505 | Pigtail (2) | 140 | | 1120 | |
| No. 6 h.d. | 505 | Pigtail (2) | 160 | | 1500 | |
| No. 6 m.h.d. | 505 | Pigtail (2) | 60 | | 1500+ | 3/4 in. |
| No. 4 m.h.d. | 505 | Pigtail (2) | 90 | | 1500+ | 1/2 in. |
| No. 8 h.d. | 505 | Pigtail (1) | 85 | | 1000 | |
| No. 8 m.h.d. | 505 | Pigtail (1) | 115 | | 900 | |
| No. 6 h.d. | 505 | Pigtail (1) | 110 | | 1240 | |
| No. 4 m.h.d. | 505 | Pigtail (1) | 230 | | 1200+ | 1/8 in. |
| No. 8 h.d. | 505 | Long (3) | 525 | | 1300 | |
| No. 8 m.h.d. | 505 | Long (3) | 570 | | 1300 | |
| No. 6 h.d. | 505 | Long (3) | 600+ | | 1500+ | 3/8 in. |
| No. 6 m.h.d. | 505 | Long (3) | 685+ | | 1500+ | 5/8 in. |
| No. 4 m.h.d. | 505 | Long (3) | 600+ | | 1500+ | 5/8 in. |
| *No. 0000 m.h.d. d.b. w.p. copper strand* | | | | | | |
| No. 8 h.d. w.p. | 449 | W.U. (5) | 700 | | 200 | |
| No. 8 m.h.d. w.p. | 449 | W.U. (5) | 185 | | 270 | |
| No. 6 h.d. w.p. | 449 | W.U. (5) | 290 | | 780 | |
| No. 6 m.h.d. w.p. | 449 | W.U. (5) | 310 | | 470 | |
| No. 4 m.h.d. w.p. | 449 | W.U. (5) | 455 | | 780 | |
| No. 8 h.d. w.p. | 449 | Long (4) | 240 | | 230 | |
| No. 8 m.h.d. w.p. | 449 | Long (4) | 145 | | 260 | |
| No. 6 h.d. w.p. | 449 | Long (4) | 310 | | 390 | |
| No. 6 m.h.d. w.p. | 449 | Long (4) | 270 | | 420 | |
| No. 4 m.h.d. w.p. | 449 | Long (4) | 430 | | 600 | |
| No. 8 h.d. w.p. | 449 | Long (4A) | 580 | | 260 | |
| No. 6 h.d. w.p. | 449 | Long (4A) | 365 | | 390 | |
| No. 4 m.h.d. w.p. | 449 | Long (4A) | 465 | | 830 | |

TABLE A. (*Cont'd.*)

DETAILED RESULTS OF TESTS

| Tie Wire | Insulator | Tie | Failure in lbs. End | Remarks | Failure in lbs. Vertical | Remarks |
|---|---|---|---|---|---|---|
| | *No. 0000 m.h.d. d.b. w.p. copper strand* | | | | | |
| No. 8 h.d. w.p. | 2782 | Pigtail (2) | 340 | | 1060 | |
| No. 8 m.h.d. w.p. | 2782 | Pigtail (2) | 170 | | 1000 | |
| No. 6 h.d. w.p. | 2782 | Pigtail (2) | 130 | | 1200 | |
| No. 6 m.h.d. w.p. | 2782 | Pigtail (2) | 100 | | 1000 | |
| No. 4 m.h.d. w.p. | 2782 | Pigtail (2) | 135 | | 1150 | |
| No. 8 h.d. w.p. | 2782 | Pigtail (1) | 440 | | 850 | |
| No. 8 m.h.d. w.p. | 2782 | Pigtail (1) | 270 | | 550 | |
| No. 6 h.d. w.p. | 2782 | Pigtail (1) | 155 | | 850 | |
| No. 4 m.h.d. w.p. | 2782 | Pigtail (1) | 190 | | 1050 | |
| No. 8 h.d. w.p. | 2782 | Long (3) | 500+ | | 860 | |
| No. 8 m.h.d. w.p. | 2782 | Long (3) | 570+ | | 860 | |
| No. 6 h.d. w.p. | 2782 | Long (3) | 500+ | | 1130 | |
| No. 6 m.h.d. w.p. | 2782 | Long (3) | 500+ | | 1170 | |
| No. 4 m.h.d. w.p. | 2782 | Long (3) | 500+ | | 1300 | |
| | *No. 4 Bare a.c.s.r. (.05 by .30 in. flat armor)* | | | | | |
| No. 6 Alum. | 505 | Long Top (17) | 820 | No pliers Tie wire broke | 1000 | No pliers |
| No. 6 Alum. | 505 | Pigtail Top (18) | 500 | | 730 | |
| No. 6 Alum. | 505 | Old Side Tie (19) | 330 | No pliers | 1200+ | No pliers |
| No. 6 Alum. | 505 | Rev. Side. Tie (20) | 570 | No pliers | 1240+ | No pliers |

TABLE B.

Summary of "End" Tests

*Bare Copper Conductors*

| Side Ties (449 Insulator) | Western Union (7) | | Long (8) | | Long (9) | | Long (10) | |
|---|---|---|---|---|---|---|---|---|
| S.D. bare Tie Wire | No. 8 | No. 6 | No. 8 | No. 6 | No. 8 | No. 6 | No. 8 | No. 6 |
| *Line Conductor* | | | | | | | | |
| No. 6 | ... | ... | 80 | 130 | 90 | 250 | 230 | 475 |
| No. 4 | ... | ... | 160 | 270 | 140 | 305 | 40 | 330 |
| No. 2 | 260 | 420 | 180 | 410 | 215 | 420 | 245 | 550 |
| No. 0 | 235 | 445 | 80 | 290 | 50 | 160 | 160 | 580 |
| No. 0000 | ... | 185 | 70 | 235 | 255 | 210 | 200 | 465 |

| Top Ties (505 Insulator) | Pig Tail (11) | | Pig Tail (13) | | Long (12) | |
|---|---|---|---|---|---|---|
| S.D. bare Tie Wire | No. 8 | No. 6 | No. 8 | No. 6 | No. 8 | No. 6 |
| *Line Conductors* | | | | | | |
| No. 6 | 15 | 20 | 10 | 25 | 50 | 140 |
| No. 4 | 5 | 30 | 30 | 20 | 40 | 45 |
| No. 2 | 35 | 20 | 60 | 40 | 130 | 370 |
| No. 0 | 50 | 45 | 75 | 55 | 85 | 290 |
| No. 0000 | 40 | 25 | 80 | 300 | 40 | 110 |

TABLE B. *(Cont'd.)*

SUMMARY OF "END" TESTS

*Double Braid Weatherproof Copper Conductors*

| Side Ties (449 Insulator) | Western Union (5) | | | | Western Union (6) | | Long (4) | | | | Long (4A) | | Long (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W.P. Tie Wire | No. 8 h.d. | No. 8 m.h.d. | No. 6 h.d. | No. 6 m.h.d. | No. 8 h.d. | No. 6 h.d. | No. 8 h.d. | No. 8 m.h.d. | No. 6 h.d. | No. 6 m.h.d. | No. 8 h.d. | No. 6 h.d. | No. 8 h.d. |
| *Line Conductors* | | | | | | | | | | | | | |
| No. 6 | 410 | 275 | 470 | 470 | 480 | 570 | 320 | 255 | 250 | 375 | 355 | 365 | 750 |
| No. 4 | 530 | 510 | 550 | 435 | 530 | 675 | 360 | 405 | 560 | 370 | 430 | 500 | 1205 |
| No. 2 | 210 | 200 | 320 | 280 | ... | ... | 390 | 250 | 320 | 370 | 440 | 282 | ... |
| No. 0 | 605 | 250 | 405 | 320 | ... | ... | 370 | 250 | 435 | 255 | 610 | 420 | ... |
| No. 0000 | 700 | 185 | 290 | 310 | ... | ... | 240 | 145 | 310 | 270 | 580 | 365 | ... |

| Top Ties (505 Insulator) | Pig Tail (2) | | | | Pig Tail (1) | | | Long (3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| W.P. Tie Wire | No. 8 h.d. | No. 8 m.h.d. | No. 6 h.d. | No. 6 m.h.d. | No. 8 h.d. | No. 8 m.h.d. | No. 6 h.d. | No. 8 h.d. | No. 8 m.h.d. | No. 6 h.d. | No. 6 m.h.d. |
| *Line Conductor* | | | | | | | | | | | |
| No. 6 | 75 | 50 | 100 | 30 | 135 | 130 | 190 | 500+ | 490 | 470 | 550 |
| No. 4 | 80 | 55 | 30 | 70 | ... | ... | ... | 365 | 525+ | 500+ | 500+ |
| No. 2 | 75 | 70 | 100 | 55 | 120 | 125 | 75 | 500+ | 560+ | 360 | 400 |
| No. 0 | 90 | 140 | 160 | 60 | 85 | 115 | 110 | 525 | 570 | 600+ | 685+ |
| (2782 Insulator) | | | | | | | | | | | |
| No. 0000 | 340 | 170 | 130 | 100 | 440 | 270 | 155 | 500+ | 570+ | 500+ | 500+ |

# Bibliography of Lightning Protection for Distribution Circuits

**Compiled by R. E. Jones, Assistant Engineer, Distribution Section Electrical Engineering Dept., H.E.P.C. of Ont.**

(*Continued from June*)

*Standard Handbook for Electrical Engineer. F. F. Fowle, 1933.*

Lightning arresters are covered in a few paragraphs. Multigap and valve type arresters are mentioned.

The use of arresters at all transformers is not justified from a cost point of view but is worth while as protecting service.

*Ferranti Surge Absorbers. Catalogue of Ferranti Electric Limited. 1933.*

Description of surge absorbers and their application with special reference to the higher voltages.

*L. M. Type A. Lightning Arresters. Catalogue of Line Material Co. 1933.*

A description and other data of a new lightning arrester.

*Westinghouse Surge Protection. Catalogue of Westinghouse Elec. & Mfg. Co. 1933.*

A discussion on the application of arresters followed by detailed description of the manufacture and other data on new Autovalve arresters.

*Ferranti Surge Absorbers, Bulletin No. 702. Catalogue of Ferranti Electric Ltd. Feb., 1933.*

A bulletin covering surge absorbers for distribution transformers. They are made for mounting on a cross-arm and also for use inside the transformer tank. The latter form is cheaper due to omission of casing and bushings.

Photos of typical installations and operating experiences are given.

*Surge Proofing Preferable to Surge Absorption. H. V. Putman, Westinghouse Elec. & Mfg. Co. Letter to "Elec. World". March 4, 1933.*

The author disagrees with principle of surge absorption and points out the weakness of a surge absorber as a piece of protective equipment. He outlines a test he would like to make on this piece of equipment.

*Lightning Protection of Distribution Transformers. J. M. Flanigen, Georgia Power Co. "Electrical World." March 4, 1933.*

There is a general discussion of the protection of distribution transformers from lightning.

The grounding of transformer tanks causes many transformer failures.

With interconnection and comparatively high secondary ground resistance there should be no doubt that this arrangement is just as safe as the present method of installing arresters.

An experimental installation of Westinghouse surge proof transformers gave very good results.

All arresters are now installed on transformer side of fuse and interconnection of grounds is used where there are 3 or more grounds on the

secondary neutral. In towns with 4 wire primary a common neutral is used.

*Surge Absorbers Reduce Wave Steepness. A. B. Cooper, Ferranti Electric Ltd. Letter to "Electric World". April 22, 1933.*

This is a reply to letter of H. V. Putman in *Electrical World* of March 4th.

Mr. Cooper points out that whereas new transformers will withstand heavy surges to ground, no mention is made of the thousands of older transformers in service which must be protected. He quotes various writers to support the efficacy of the absorber in reducing the steepness of the wave front of a surge.

*Westinghouse Surge Protection. Cat. 38. Westinghouse Elec. & Mfg. Co. May, 1933.*

A short description of the action of travelling waves followed by a discussion of the desirable features of an arrester.

In general, insulation will not be damaged by surge voltages which do not exceed 2½ times the normal voltage rating of the apparatus.

A lightning arrester is not designed to carry a large flow of current for more than an extremely short period of time.

One ampere flowing for .2 second represents the quantity of power flowing through an arrester in the extremely short period of time taken to discharge a heavy surge.

Grounding of the primary neutral (at any point) prevents arcing grounds which are destructive to arresters due to repeated discharges.

Solid grounding of the neutral is better than grounding through resistance or reactance.

A grounded system permits the use of arresters of reduced rating.

Five l.v. (distribution type) arresters in parallel equal in protective value one s.v. (station type) arrester.

On solidly grounded systems the use of an arrester with lower than phase to phase voltage rating is recommended as giving better protection.

Grounding of tanks is recommended.

Interconnection of primary and secondary grounds is discussed.

A description of the manufacturing and routine testing of l.v. arresters is followed by data on surge generators and cathode-ray oscillographs as manufactured by this company.

*Crystal Valve Lightning Arresters Catalogue. Electric Service Supplies Co. June 1, 1933.*

Lightning protection for distribution transformers is discussed, including a review of current practice.

This is followed by a description of Crystal Valve Arresters and data on their application.

Apparently the following manufacturers as well as the General Electric Company have placed the arresters inside the transformer tank:—

Can. Crocker Wheeler Co.; Duncan Electric Co.· Kuhlman Electric Co., and Wagner Electric Co.

Data on the testing of grounds is included.

*Recommendations for Impulse Voltage Testing. A.I.E.E. June, 1933.*

This is a report of the A.I.E.E.

Power Transmission and Distribution Committee. It outlines recommended test procedure and three preferred impulse test waves, with a view to standardization between various laboratories.

*Impulse Voltage Testing. C. F. Harding and C. S. Sprague, Purdue University. A.I.E.E. June, 1933.*

After re-designing several manufacturers' transformers were tested in the laboratory with the surge generator. They were protected with arresters or equivalent internal equipment and withstood all tests. However, without protective equipment the surge flashover of bushings and puncture of insulation varies with different manufacturers of so-called surge proof design.

Tests were made between various terminals on different transformers, with and without arresters.

Bushings were tested and 60 cycle and impulse flashovers of primary and secondary bushings are given.

Interconnection of arrester ground and secondary neutral with usual city conditions of a multiplicity of low resistance grounds definitely limits transformer stresses.

There should be a reasonable ratio between the various insulated parts of a transformer.

If interconnection of grounds results in reduction of lightning troubles on non-surge-proof transformers, the added cost of surge-proof transformers may be justified only for special installations.

It seems likely that the insulation of a transformer may be punctured by impulse voltage, and later withstand line voltage.

In the discussion, D. W. Roper stated that to make check on the value of interconnection, the Commonwealth Edison Co., in 1932 installed 3,000 interconnections in blocks scattered over the city. Records show a 60 per cent. reduction in burnouts and fuse-blowing in these blocks. Permission was obtained to make these interconnections from the Illinois Commerce Commission with the proviso that in addition to two ground rods, the secondary neutral would be tied to the water pipe at the services.

*Series Dissipators for Lightning Protection. W. R. Spittal, Ferranti, Inc. "Electrical World." July 15, 1933.*

Both the terms "surge absorber" and "lightning arrester" are misnomers.

A modern arrester has a time lag of 1 micro-second during which time the discharge will travel 1,000 feet.

On the other hand a dissipator operates instantly. It operates on the steepness of the wavefront and not on the amplitude. The latter may cause flashover of bushings or to case but it is the former that causes failure of the windings.

The operation of the dissipator is given under various conditions. Graphs are given showing the effect on $1 \times 5$, $1 \times 10$, and $1\frac{1}{2} \times 40$ waves. The reduction in amplitude is much greater on the $1 \times 5$ wave than on the others.

Some operating experiences are quoted.

*Lightning Protective Equipment. L. B. Chubbuck, Canadian Westinghouse Co. "Elec. News & Engineering." Sept. 1, 1933.*

The relative value of arresters and surge absorbers is discussed.

A graph is given showing the effect of arrester and absorber on a steep wavefront surge ($1\frac{1}{2} \times 40$). While the arrester allows a certain rise in potential before operation, the absorber slopes off the wave from the start.

*New G.E. Pellet Lightning Arresters Catalogue. Canadian General Electric Co. Nov., 1933.*

Description of new Pellet arrester.

*National Electric Code, 1933. Sec. 909K.*

The grounding conductor of a lightning arrester protecting a transformer which supplies a secondary distribution system may be interconnected with the grounded conductor of such secondary distribution system provided the secondary has elsewhere a grounding connection to a continuous metal underground water piping system in addition to the direct grounding connection at the arrester. Otherwise such interconnection may be made only by special permission.

* * * *

*Lightning Measured on 4 kv. Overhead Circuits. H. Halperin, Commonwealth Edison Co., and K. B. McEachron, General Elec. Co. A.I.E.E. Jan., 1934*

This study supplements the work carried out by D. W. Roper. Measurements were made of surges on two distribution lines of a large urban system.

The principal conclusions are as follows:—

1. Lightning voltages at transformers are reduced materially by the use of arresters.
2. Usually arresters on urban circuits must be capable of discharging successfully surge currents less than 300 amperes.
3. With the arrester ground and secondary neutral main interconnected, only the arrester potential appears between the primary coil and the secondary neutral main.
4. Known direct strokes had negative polarity and the maximum voltage was 488 kv.
5. Where there was no evidence of flashover, the voltages recorded on these distribution lines in open territory with little equipment were about 300 kv. or less.
6. Voltages below the flashover value of the line insulation probably were induced surges, and for the higher voltages there was a preponderance of negative surges.
7. The probability that high lightning voltages may occur at transformer locations on long circuits is 10 or 20 times as great as that for urban circuits. The probability of direct strokes is remote.
8. For long circuits, lightning voltages caused by a single cloud discharge seem to cover 1000 to 3000 feet of the line. Generally on urban circuits the voltages are restricted considerably more by the closely spaced arresters.
9. Usually in urban territory the maximum lightning voltages impressed are considerably less than 200 kv.

10. For lightning voltages of the same magnitude, the insulation of transformers having the interconnection is stressed considerably less than insulation of transformers having normal arrester protection.

The Chicago distribution system is described. For the most part the secondary neutrals of adjacent blocks are tied together. The secondary neutral is grounded to driven pipes and to water services.

The combined secondary ground has a resistance of less than one ohm.

General Electric stationary film type surge voltage recorders were used, about 100 being installed.

During the investigation, 1833 pairs of films were developed.

*Heavy Surge Currents, Generation and Measurement. P. L. Bellaschi, Westinghouse Elec. & Mfg. Co. A.I.E.E. Jan., 1934.*

A statement of the requirements of a surge generator is followed by a description of the method used to construct a generator capable of giving a discharge of 100,000 amperes.

*Transformer Proofed Against Lightning and Overload Burnouts. H. V. Putman, Westinghouse Elec. & Mfg. Co. "Electrical World". Jan. 13, 1934.*

Description of an improved distribution transformer.

Field experience and laboratory tests have demonstrated that moderately high surge current will blow a 10 ampere fuse link.

In the smaller sizes of the transformer a small Deion breaker is inserted in the secondary circuit with its tripping mechanism controlled by a thermal element immersed in the oil. This latter feature allows greater load to be carried when the ambient temperature is low.

Inside the case there are fusible links to protect the line from a failure inside the transformer. Lightning protection is by Deion gaps. External cutouts and also arresters are not necessary with this transformer.

*Full Lightning Currents Attained in Laboratory. P. L. Bellaschi, Westinghouse Elec. & Mfg. Co. "Electrical World." March 24, 1934.*

A short discussion on the characteristics and use of a heavy current surge generator. At Sharon there is a large surge generator with an output of 100,000 amperes sustained in excess of 100 micro-seconds.

Lightning-stroke currents range from 10,000 to 20,000 amperes up to a maximum of 150,000 with a duration to ½ value of about 20 to 100 micro-seconds.

## Eugenia Falls

A recent issue of *The Mail and Empire* contains a short article by Fred Williams, entitled "Torontonians Developed Eugenia Falls." The story begins in the early 1850's when "many people were attracted to the falls of the Beaver River by the beauty of the scene." From that time until the falls were acquired by the Hydro-Electric Power Commission of Ontario for development the events as recorded by Mr. Williams were as in the following.

Government surveyors were sent to locate a town near the falls. The Crimean War was the news of the

day and the streets of the future village were given such names as Alma, Balaclava, Inkerman. It was also the day when Empress Eugenie was swaying the court of the Tuileries with her brilliant social gifts, and in the government party was a French ex-soldier who urged that his beloved Empress be commemorated in this beauty spot in the Canadian wilderness. The place was named Eugenia, the falls naturally sharing in the name. But no one imagined that the falls were destined to become a means of supplying light and power to hundreds of homes, for who then foresaw the electrical age? The History of Grey County (quoted in the eightieth anniversary number of the Owen Sound *Sun-Times*) tells us that in the early sixties a man visited the falls on the Beaver River while following on foot a trail to the village of Sydenham (now the city of Owen Sound), who later wrote to his friends: "There is a great water power on the river called the Beaver. I foretell the time is not far off when it will be made use of." It was years, however, before this wonderful water power was anything but the dream of a few.

In the early '70's came a man of foresight, William Hogg, who built a sawmill a few miles from Eugenia. So impressed was he with the power that he also acquired the falls proper and some adjacent property. Through his efforts in 1895 a small electric plant was installed, which supplied light to Eugenia and also the village of Flesherton five miles distant as well as electric power to run a chopping mill. Mr. Hogg endeavored to obtain co-operation in Toronto for further power development but, though an active interest in Niagara was being shown, they would not hear of the falls high on the Beaver River. Eugenia in its primitive beauty remained unchanged.

It was not until the year 1905 that any further attempt was made to use the power at Eugenia. A Toronto syndicate, known as the Georgian Bay Power Company, acquired the falls and several properties up the river. For the purpose of a storage dam they also bought property between the high banks several miles farther up. A hydraulic engineer was engaged, who estimated a possible "working fall" of from 300 to 500 feet. A promise of necessary capital to finance the undertaking was secured on condition that an engineer chosen by the capitalist, the late Cawthra Mulock, should consider it favorably. This engineer estimated the power output as too small to be commercially profitable and added that topography of the site would make storage dams impossible. But the members of the company were not to be discouraged. They engaged another engineer. His report was vastly different. He estimated a 2,500-horsepower output with a 400-foot head. Another leading engineer confirmed this report and gave a certain 5,000 horsepower and a 475-foot head.

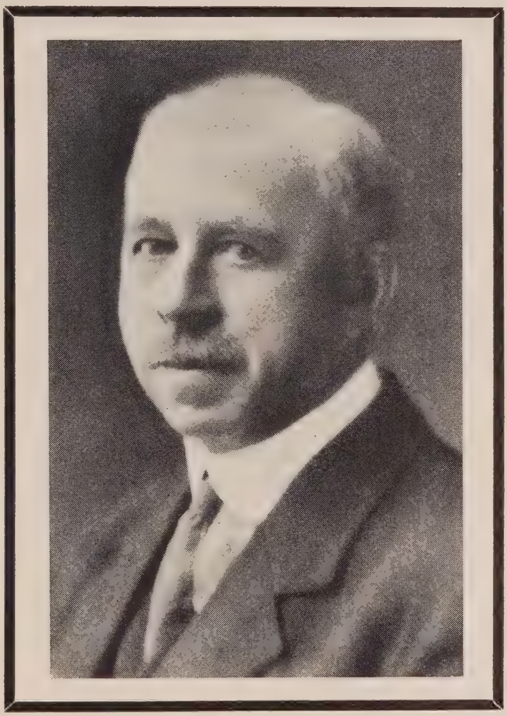
In the meantime the Hydro-Electric Power Commission of Ontario came into existence and as early as 1906 made some preliminary investigations at Eugenia. There remained only for the owners of Eugenia Falls to await the time when the Commission would decide to acquire the property. It was not until 1912 that negotiations to this end were brought and, after a lapse of nearly two years, the various properties constituting the power development and the valuable water storage power sites at Maxwell bridge up the stream were taken over by the Commission.

# THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

The Honourable
**John Robert Cooke**
1866 - 1934

AUGUST, 1934

THE HONOURABLE JOHN ROBERT COOKE, former Chairman of the Hydro-Electric Power Commission of Ontario, died at his home on the Eighth Concession of Rawdon Township (near Harold, Hastings County), Ontario, on the evening of Monday, August 13, 1934. His death was caused by injuries received in an automobile accident on the preceding Friday evening.

Mr. Cooke was born on the first day of September, 1866, the son of James and Margaret Duggan Cooke, both pioneer settlers from Ireland, who, about 1850, made their new home in Canada. His early life was spent on the farm where he was born, attending Stirling Public School and Campbellford High School. Following the occupation of a farmer, he was also an earnest student and sought by careful reading and contacts to improve and broaden his outlook upon social and public problems.

In 1900, Mr. Cooke was elected Councillor in Rawdon Township, and held this office continuously until 1908 when he became Deputy Reeve. In 1910 he became Reeve. The following year, Mr. Cooke was elected by acclamation to the Ontario Legislature for North Hastings. He was re-elected in 1914 and again in 1919, in 1923, in 1926 and in 1929.

In July, 1923, Mr. Cooke was made Minister without Portfolio, and later in the month was appointed Commissioner on the Hydro-Electric Power Commission of Ontario. When Mr. C. A. Magrath retired in February, 1931, Mr. Cooke was made Acting Chairman. In June of the same year he became Chairman and continued as such until his retirement in July of this year.

Mr. Cooke is survived by his widow, one brother and two sisters, to whom we extend sincere sympathy. He was very kind and considerate, and esteemed by all members of the Commission's staff, officials of Ontario Hydro utilities and all others associated with him in his public and private life.

# Work of the Research Council

By Dr. H. M. Tory, President, National Research Council, Ottawa

*(Address to Association of Municipal Electrical Utilities at Ottawa, June 28, 1934.)*

WHEN Mr. Dobson asked me if I would come to your convention and talk to you on the work of the National Research, I took it for granted that you would not expect a technical paper, but rather a general talk on the aims and purposes of the Research Council, that you might have a mental picture of our activities.

The National Research Council, as it exists in Canada, is part of a world movement. In reality, it is a movement which began a good many years ago but which was intensified enormously during the War and took form and shape, so far as we in Canada are concerned, during that period. I say it is part of a world movement because prior to the foundation of the modern research councils, great national organizations were being called into being in every country in the industrial world for the purpose of promoting science in its relation to national developments along industrial lines.

About a year or two ago, I published a little paper, called Progress in Industrial Research, and in that I set out what developments were taking place in the world along this line and it shows how modern the movement is and at the same time, how large and extensive it is. If any of you are interested and would care to have a copy of this paper, I would have copies sent to you on request.

In the first place, let me say that when the National Research Council was founded, it was not intended to be a rival of any other organization in Canada. It was not started as a rival institution to any other government department, nor as a rival to the industrial organizations in connection with the great industrial developments that have taken place, nor as a rival to the research organizations of the universities. It was rather started to be complementary to all of these, in order to enable us to better co-ordinate the efforts going on in our own country, that we might make our research in relation to its normal development more efficient.

I say that, specifically, because there has been some little misunderstanding, even in Ottawa. Some of the government departments conceived it to be a rival institution. It is not. It is intended to be a co-ordinating agency helping in the development of scientific research, wherever going on. To prove this, I want to give a little sketch of its history:

The very first thing it did was to take stock of the agencies working in the country. It visited all the universities and laboratories that had men at work, to find out to what

## CONTENTS

**Vol. XXI** **No. 8**

**AUGUST, 1934**



extent they were already equipped for scientific research, in order that they might determine in what way we might best stimulate the service. That was the motive.

There are in the files of the Research Council documents which show, at the same time that stock was taken, the names and equipment associated with practically every laboratory in the country, but especially the university laboratories. This was done in order to get a picture of what was going on and to find out how it would be possible to render assistance.

When the stock-taking was completed one outstanding thing was apparent. This was that there was a great lack of men in the country, actually capable of doing fundamental work. Some of our universities were carrying on research under individual professors of the greatest distinction, but, generally speaking, there was a lack of trained men and a lack of equipment to enable trained men to work effectively. That was largely due to the fact that there was very little work of a graduate type going on in our universities. As most college men know, during our undergraduate life we learn to master knowledge as it. Only when we enter the graduate school do we come in contact with methods of promoting the discovery of knowledge. That was the situation in our universities.

The first thing the Research Council did was to make plans to stimulate interest in the centers of education. The result was that our system of scholarships was founded; that is to say, we organized a system of scholarships, so that capable men from the universities who had finished undergraduate work and desired to go on for further training should have the advantage of financial support. We instituted bursaries for the men just beginning, student fellowships and fellowships for men, leading to doctors' degrees. These have been carried on ever since. At one time we were giving about $60,000 a year in scholarships. Unfortunately, the times have made it necessary to reduce that activity. It is our intention, as soon as circumstances warrant, that it will be again revived on as large a scale as is consistent with our budget.

The result has been that we have had a great number of men trained in our universities, but the most important thing is that we have had a development of graduate studies and graduate schools organized in three or four of our old universities, on a scale which put us in a position comparable with the great universities of other countries. I think I am justi-

fied in saying that the work of the Research Council has been largely responsible for bringing about that state of affairs.

The second thing we tried to do was to stimulate research in the universities by making it possible for the teachers in our universities to undertake work themselves. To this end we established a scheme of assisted researches. That is to say, if some university professor who had an interest in a particular type of work, was unable to carry on because of lack of equipment or lack of help, we gave him the privilege of applying to the Research Council, with a statement of what he wanted to do, and of asking for such assistance as would be necessary to enable him to do it. The assitance was granted in two ways: First, to buy equipment necessary, over and above the normal equipment of his laboratory; and, second, to employ students or young, competent men in his laboratory, in order to take the burden of routine work off his shoulders and enable him to concentrate more definitely on the scientific aspects of his work.

That plan met with great success. Since the Research Council was founded, we have supported some hundred and fifty researches in the universities. Last year, we had thirteen such researches going on in the universities of Canada by men who were still able under the hard pressure on the universities today to keep research going. Our aim has been to keep alive the spirit of research in our universities during these hard and difficult times.

All experience has shown us and I think the men in the large industrial laboratories of the world would agree, that from an industrial point of view the most successful researches are those developed on an organized basis where a major problem is attacked by a group of scientists working together. In order to undertake researches in this way we established a system of Associate Committees. For example, we have a large committee working on the problem of prevention of tuberculosis. First, a complete review of all previous work was made. Then a programme of research was blocked out. The co-operation of chemists, biochemists and biologists was sought and obtained. A special attack was made on tuberculosis in animals. This work is still going on and on a scale in so far as the number of experimental animals is concerned, never before attempted.

Similar committees are at work on large industrial problems. One on problems connected with the asbestos industry, another on the magnesium product industry. In all, thirty-four such committees are working under the authority of the Council. In all such cases the problems are of such a character that they could not be successfully attacked by one man.

The researches undertaken by the Associate Committee method have been most fruitful. I have stated on various occasions that I think a few of these large researches have resulted in national savings sufficient to warrant us in saying that we have already repaid to the country the whole amount spent in the development of our research organization. I think that is a statement that can

be justified by the facts and I could prove it to you if time permitted.

We found it necessary, of course, to develop our own laboratory system. You will see down on Sussex Street quite a large building. It has been fitted for development work in three of the great sciences—Engineering Physics; Biological Science which includes agriculture as well; the Chemical Sciences which include all branches of chemistry.

I suppose, from the point of view of the actual application of science to industry, chemistry represents the greatest individual interest at the moment, but the combination of these three sciences practically cover all the applications that are now being made in the industrial life of the country or in the application of science.

I have here a mimeographed statement of the activities of the Council for 1933 and 1934. If any of you are sufficiently interested and would like to see some of the details of what is going on, I would be glad to send a copy of this document. A note to the Research Council with your address would enable me to send this to any of you who desire to have it.

In these laboratories we have these four great divisions—Physics and Engineering Physics, Biology, Chemistry and Research Information. As a branch of the Engineering Physics, we have Aeronautics and the research work which is associated with the problems of aeronautics. There is a section of our laboratory devoted entirely to these engineering problems. Some of you, I am sure, would be interested in seeing that section of our work because it is on an engineering scale of some magnitude and would be of special interest. Professor Parkin is in charge of the work. I did not ask him but I am sure he would welcome any of you at any time.

In addition to the development of our laboratories we started with another associated project. We have need in Canada for a central scientific library. We have a great many small scientific libraries. Our universities have been trying to build their library systems. I know, from twenty-five years' experience, how difficult it is to get money for libraries and how difficult it is to build a library. So we conceived the idea of a scientific library to be of service to the scientists in the country, generally. We reserved a space in our building that would hold half a million volumes. We have only the beginnings of that. Already it is being widely used by scientific men all over the country. It is under the direction of the Division of Research Information. This Division was established for the express purpose of helping to dig out the material that lies in the journals and libraries on any technical subject on which anyone may want information, including the members of our own research staff. I just made an estimate this morning and I have the facts in the document just mentioned. Last year, we made a hundred and one reports on applications sent to us by industrial concerns all over this country and by university men seeking information. I found that we really issued in printed matter, about two thousand pages in those hundred and one documents—

two thousand pages of information, related to definite specific problems sent to us as enquiries from some who wanted the information that they might apply it in connection with their business. This, I regard as a very useful application of the principle of our ideas on research work by stimulating the work in all parts of the country. We invite enquiries and that division of our work has been built up for the express purpose of seeing that the information that in most countries can only be found in the great old libraries would be made available to the people of the country.

Then we have contacts with outside libraries to get the information we do not have in ours. We are taking about a thousand of the leading scientific journals of the world and these are being brought systematically and regularly under review, in order that the latest information on any subject may be made available to our own workers.

Last year, in addition to the above, we answered approximately three thousand enquiries by letter. We have a constant stream of enquiries coming in now. They are coming all the time from people interested in particular problems, writing to ask if we can give any information. I am speaking merely of enquiries that can be answered by letter without looking up or preparing reports on them

Some, as you may know, are not very sensible enquiries. The number of people who work at perpetual motion and think they have it in some form or another is still surprisingly large. In spite of our education, nearly every week somebody comes along with a crazy notion, exploded a hundred years ago as being impossible. Occasionally, the man who exploded it was wrong. We try to give fair and honest opinion on the questions people bring to us that might have a bearing on some industrial problems.

Permit me to say in this connection that there is one kind of man of whom I have become very suspicious. He is the man who has a secret which he won't tell you, but who is sure that he is going to save the British Empire if you will only do the thing he has in mind to do—if you will only give him some help without knowing what he is going to do. Where it is a question of money, our answer is in the negative to that kind of application.

May I add another word: Sometimes you see references to our work in the press and it would appear that some people have the impression that we have been duplicating some work done by others. There are certain kinds of work that you cannot help duplicating. If John Smith is working privately in a laboratory and does not tell anybody about it, and somebody is working in our laboratory and does not tell anybody about it, naturally, they may be working on the same problem. It is all to the good. If an idea is worth while, more than one man should be working on it. So far, however, as we know from public information given through the scientific journals, we know from published reports regarding research under way, we have never duplicated the work done by others. I want to say that with all the emphasis I can. Our work is not

a work of duplication. It may be a work of expansion. The problem may be half solved and we try to finish it. Further, we would work with any organization that has a problem that it would like to have solved and has a man on whom they depend for the solution. To any industrial organization, we offer the opportunity of our laboratories for the purpose of working out a problem of that sort. That is part of the plan of our organization.

We would welcome assistance in the form of scholarship from individual concerns to put a man to work on an individual problem. If the man pays for the work, the results are his. If we pay for it, it is ours. In any case, the public gets the benefit. A number of people are taking advantage of this plan. Individual firms are paying the total cost of researches suggested by them. The problem is theirs and we are trying to help them work it out, giving guidance and help to the researcher. In that way, we are working somewhat after the fashion of the Mellon Institute.

We are aiming to have Canadian work done by Canadian men, trained in our Canadian universities. I have been for years in university work and I have had it in my heart all that time to stop the constant stream of men—the best men—going from our universities abroad to study and never returning. I knew that could never be stopped until we built up a system of higher training in our universities, thus giving our best men the opportunity of mastering the methods of research without going abroad and then finding tasks for them at home. That does not mean that I do not want men to go abroad. I believe that we should send more men abroad, but they should be men whose education is finished at home.

I have a definite recollection of what I found in Japan in 1926, where scientific organization for industry is on a scale known in no other country in the world. Every year Japan is selecting three hundred of their top notch men and sending them abroad to every nation in the world to bring back, after a year or two of study, the ideas they found existing in other countries.

May I make the remark that when I came back from Japan in 1926, I happened to listen to an address from a very distinguished Canadian orator in which he was expatiating on the great Oriental trade development in the future, saying that our river valleys in British Columbia would be filled with mills supplying the millions of the Orient.

I was called to move a vote of thanks and I ventured to make the statement, that after what I had seen in Japan, I would suggest that within ten years, the competition of Japan in the industrial life of the world would be on a scale that would completely reverse the picture if we did not, ourselves, get busy.

That was eight years ago. I ask you to recall what is going on today when some of the greatest industrial nations of the western world are looking for methods to protect themselves against what has developed in Japan in recent years. I use that as an illustration of the value of organized educational methods. In no other country in the world has such

a development been achieved in so short a time.

There is another activity of the National Research Council to which I wish to refer, viz., our standardizing work. If you will look at our Act, you will find it defines our work as a Bureau of Standards for the nation. Now, we have been developing our standardization work especially in relation to electrical standards. We are trying to develop in Canada a system of standardization comparable with those in the United States Bureau of Standards and in the national physical laboratories in Great Britain. All our standards are being set up after having been compared with these organizations. To be independent regarding fundamental standards is our objective. Electrical and corresponding standards in other directions are now being set up. Upon us was put the responsibility of standardizing all electrical measuring instruments and equipment. We have one of our large committees working on that—a sub-committee in our laboratory and a general committee that covers the industry engaged in the production of these instruments, as well.

We are also developing, in association with that, a testing equipment for testing against specifications. That is to say, we hope in due course that we will have in Canada a complete testing laboratory, capable of doing the work in Canada which is now being sent to other countries to be done.

There has been a good deal of discussion of the wisdom of our doing this. Personally, I have no doubt of the wisdom of it. I have no doubt we shall never get in the proper position in our industrial development until we are self-contained in the sense that we are not dependent on other people for our ideas. In other words, the time has come when we must cease to be mere copyists. We must develop our own country by the use of our own brain and material. No one feels this more strongly than I. I have been urging it for years. I am not speaking in a political sense; the political problems will take care of themselves if we look after the intellectual and material side of our development.

At the present time we are developing a series of special standard specifications for government purchasing. These will be worked out by a committee within the departments of the government and the related industries.

To summarize briefly: During the current year we have twenty-five men working on scholarships in our universities; we have thirteen researches going on under university professors receiving assistance from the Council; we have thirty-four Associate Committees dealing with larger problems, in which university men are co-operating with members of our own staff; eighty researches are underway in our own laboratories; we issued one hundred and one reports resulting from applications for information requiring research into scientific literature; we answered approximately three thousand enquiries by letter from commercial firms and others interested in some phase of the application of science; we made approximately three thousand tests of materials for

government departments, commercial firms and individuals. These tests were made either in relation to standard specifications or subjects of research and not in competition with commercial laboratories.

In addition, last year, we published from the laboratories, twenty-eight scientific papers.

I would like to call attention to one other activity—the publication of a Journal of Research. In the past we have been dependent on foreign journals in order that scientific work done in this country might be published. A few years ago we started a journal known as The Canadian Journal Research. It opened its pages to anyone in Canada doing research work, worthy of being published. We have already published eight volumes of research stimulated largely by ourselves. That is a monthly journal, containing a hundred to a hundred and forty pages in each issue. In that journal, we are publishing most of the scientific work done in our laboratories as well as material sent to us by the universities.

We aim at the development of a plan which will undertake any investigation associated with the possible use of the natural resources of Canada. At the present moment, we are planning a more intimate survey of our natural resources. Let me give an illustration: We are importing something like $40,000,000 worth of chemicals. Of those, about $10,000,000 come in as unclassified. That is to say, there is a fixed tariff on them. They are unclassified, further than that. We have been making a complete study of the importation with a view to see how they relate definitely to the material in Canada to be used in connection with their production. In that way we hope to stimulate the use of our own materials. That will serve as an illustration of a general problem that is before us all the time, a complete study of the relation of our own materials to our own needs.

One of the greatest contributions the National Research Council has made has been the stimulation growing out of the activities of the Council of the work of research generally in the country. I think that no one will deny that we have stimulated activity in the government itself. We have enormously stimulated activity in the universities and we have made possible some of the graduate departments. There are one or two on a par with any in the world. I think the men of those departments are the first to say that the work of the National Research Council has been a tremendously stimulating influence.

After all, the basis on which we must build industry is the basis of knowledge. You can get a great many props to temporarily help industry, but in the long run the people who get down to the hard facts and put industrial development on the basis of accurate knowledge are the people who will stand in the long run against the competition of the world.

My thought was to bring in outline the purpose of the Council as established, the scheme under which we are organized and just a taste of the nature of the work we are doing. You cannot get the rest without reading some of our documents and I invite you to enquire and get the documents.

# Load Building through Good Customer and Dealer Relationship

**By O. M. Perry, Manager, Windsor Hydro-Electric System**

*(Presented to Association of Municipal Electrical Utilities at Ottawa, June 29, 1934)*

WE are told that confidence is the foundation of successful business. Confidence of the public in any electric utility must be earned, and the effort of earning must start from the top and permeate the entire personnel. No one in the employ of the electric utility has the right to feel that he is exempt from the duty of building public confidence for his organization.

It is taken for granted that the successful organization will have employees who are clean and neat in appearance; courteous in treatment to everyone; orderly in habits and conduct; prompt in attention to duty; willing to work and give their best at all times, and thoroughly understand the product and service they are selling. The whole organization should radiate friendliness and good will, keeping always in mind they are servants of the public, charged with the duty of providing electric service, and this electric service does not consist of kilowatt-hours only.

Hydro is the greatest adventure in public ownership the world over, and is unique in the fact that it is municipal and not governmental in character. In no other country have municipalities joined together in such a co-operative and gigantic undertaking. For this reason alone, those who are responsible for its management and operation have a greater responsibility thrust upon them. Every contact made with the customer must be made with the thought in mind, that the customer is his employer—which virtually he is. He is a part owner of the great Hydro organization. His credit has been used to establish the system.

It is the duty of Hydro officials to see their customers get the greatest use of the service for the least cost. Hydro's ownership being so wide spread makes it peculiarly vulnerable to criticism, and its affairs should be carefully conducted to avoid this.

If it is the duty of Hydro commissions to provide its consumers with electric service at the least cost, then it is also the duty of each commission to encourage and increase the use of electric service. The cost per kilowatt-hour is at its lowest when the number of kilowatt-hours used is at its greatest.

Hydro-electric power when used for water heating and cooking is the only fuel that when once used, does not lessen the natural resources of the country. The others are gone, used up, never to return. Hydro-electric power comes from an inexhaustible source.

The use of electric service in the home has increased at a rapid rate in the last few years, but it has a long way to go before the maximum use is to be reached. There are thou-

sands of homes in the Province that are not aware of the great advantages of electricity for cooking, water heating, refrigeration and the many other household uses. Many homes will never know of these great advantages unless told by their own Hydro Utility and after all, is there any other better or more logical source where this information can be expected?

Before the depression, demands for power almost exceeded the supply and Hydro's great task was to find sufficient power for the needs of the Province. With a falling off in power requirements for industry and the commercial life of the Province, attention has been directed to the household. This is the big undeveloped field. This is a load that will not have the big fluctuation as commercial lighting and power. Whether times are good or bad, the business of living must be carried on, and once electric service is firmly established in the household, it is there to stay. The fact must be admitted that up to the depression years, Hydro did not need much selling. The most of us were order takers, but necessity has demanded more aggressiveness, and to replace loss of load in industrial channels, the logical place for development is the domestic field.

The utility ready to go out and actively work for load increase is best equipped when it has a Hydro Shop. The Hydro Shop should be conducted on a high merchandising plane. Price cutting and long-term credits should find no place. The thought in the operation of the Hydro Shop should not be merchandise sales, but it should be kilowatt-hours. With the thought centred on kilowatt-hours used and not on merchandise sold, it should not be an important matter if the shop shows an operating loss at the end of the year. Any loss experienced in shop operation should be charged to advertising or promotion of business. If the operation of a shop is done for the sole purpose of making a profit on goods sold, then the utility would be justified in selling merchandise foreign to the electrical field. Operate the shop in an exemplary manner, take no advantage of Hydro's stronger financial standing, and if money can be made on its operation, so much the better, but this fact alone is not important. In fact, any loss experienced will be a very small percentage of electricity sales. With shop operation viewed from the standpoint of advertising, activities in this line should not be confined to shop operation, but should be extended to other fields. Newspaper advertising finds an important place in every aggressive utility, and this advertising is best used to advantage when the use of electricity and service is featured, rather than the sale of any specified manufacturer's product.

The electric utility does its best work when there is close co-operation with the private dealer. They should not be competitors in any way. Their interests are identical. One does not prosper without the other. The electric utility will be better off with strong prosperous dealers in its territory, and on the other hand, the dealers will gain with an aggressive utility bent on increasing its electricity sales. The Hydro System should do everything in its power to assist its dealers and should in no way compete with them in merchan-

dise sales. The utility should be content when the appliance bought is an electrical one, and should not be concerned whether it is bought in its own shop rather than that of the private dealer. This policy of non-competition with the dealer cannot be carried out with the utility salesmen on a whole or part commission basis. The salesman, being a very human individual, must be remunerated on some other basis, so that he is not of necessity forced into active competition with the private dealer.

Those municipalities who are now conducting a range campaign are experiencing a dealer co-operation that should be productive of much good and this co-operation should become a fixture in the utility's policy.

If we are to encourage the householder to a greater use of electricity, we should make it as easy as possible for him to do so. High cost of repairs offers little encouragement to the use of electrical appliances, and in many cases, becomes a serious disadvantage. An electrical appliance out of repair and lying on the shelf is no user of electricity, but if the customer knows that his utility has a policy that permits of cheap repairs, the possibility of that appliance returning to active service is much better. In our own case, in Windsor, labour on appliance repairs has always been without cost, charge being made for materials only, and this free labour charge applies to all appliances on the system, regardless of where purchased. In 1933 we repaired 9,287 appliances in the home, and in addition, 3,708 smaller articles brought into the shop or a total of 12,995, all without charge for labour.

We have in Windsor nearly 15,000 domestic consumers. If by reason of advertising, free appliance repairs and other means, we were able to increase the average daily use by 1 kilowatt-hour (and this by no means is unreasonable), we would increase our net revenue by $59,000.00. It is my personal opinion, after many years' experience, that free labour servicing of appliances is sound, and justifiable from a utility standpoint.

So far have been mentioned, the Hydro Shop, closer dealer co-operation and free service as a means of building load and customer good will, but in my opinion, this is not sufficient in itself. We must go farther and contact the customer in the home. The most of us have been waiting for the customer to come to the utility and show his interest in things electrical. Would it not be much better for the utility to go to the customer? If we feel we have a good story on electrical service to tell, why wait for the customer to come and ask for it? The one who asks for it, probably requires it less than the person who shows so little interest that he will not even inquire. We, in Windsor, have for about one and one-half years adopted the policy of assigning field men to a certain defined district, for which he is responsible. He makes regular calls, explains he is from the Hydro, that he has nothing to sell. He is calling to make sure that the Hydro service is satisfactory in every way. He invites criticism or complaints. Very often he discovers customers who are annoyed over some grievance, usually a slight one which sticks in the customer's mind. He does everything he can to correct matters and to

leave the customer in a happy frame of mind. To one person who will come into office and demand a showdown over unsatisfactory treatment, there are nine others who will nurse their grievance, who will say nothing to the utility, but who lose no time in telling their neighbours. By going into their own home and asking for criticism, they soon uncover it, if it is there. At the same time, he talks Hydro service, explains that in case of fuse trouble he can have them replaced day or night, the year around. He lists the appliances used, finds out if any need repairs, and explains our repair service—its cheapness and the fact that monthly payments can be made on repairs. Water heater and range campaigns are explained, and they are told how easy it is for them to acquire these two major appliances. He does his best to get them to think in terms of electricity, to get them electrically minded if you will. He leaves his card, and asks them to get in contact with him in anything pertaining to Hydro matters, and that he is charged with the duty of looking after their interests. Very often he finds they are interested in some particular appliance, and will be prepared to purchase at some later date. He makes a note of this, and explains that the article may be purchased at the Hydro Shop or any good dealer, and follows up the matter later, to make sure the customer does get the desired appliance. He finds in many cases electric stoves in such poor repair that the customer, thinking the repair costs are excessive, is seriously thinking of some other type of fuel. He explains our new stove burner prices, where new burners are replaced in the stoves at slightly more than cost. The sale of burners on this basis is not a merchandising one, but under present conditions, was a move prompted by necessity.

The value of the field men in their respective districts is measured not in terms of merchandise sold, but in terms of kilowatt-hours. If the kilowatt-hours sold in a certain district in a given period this year, is in excess of the same period a year ago, then we know that definite progress is being made.

To sum up briefly: If we are to increase our electricity sales, we must get ourselves into the proper frame of mind, and have distinctly before us what we wish to achieve. We must, through friendly relationship and fair dealing, create a spirit of confidence between the customer and ourselves. We must impress on the customer that we are working in his interests, that we as Hydro employees are virtually the servants of the public. We must enlist the co-operation of the private dealer, and help him in every way possible. Let the dealer look after the merchandise sales, which give him his bread and butter, and these same merchandise sales will produce kilowatt-hour sales which give you and me our bread and butter.

Let dealer and utility work hand in hand, for their paths lead in the same direction, to the same ultimate end. Make it easy for the customer to own an electrical appliance and once he owns it, make it easy for him to keep it in service.

Co-operation with the dealer and good service to the user, can not but result in an ever-increasing use of electric service.

# The Usefulness of Foot-Candle Meters

By G. G. Cousins, Engineer in Charge, Illumination Laboratory, H.E.P.C. of Ontario

IN order to make the most intelligent use of facilities which enter so largely into our lives it is necessary to have some conception of the quantities available and what a definite quantity represents in usefulness, and also what quantities are required for various uses. The use of electrical power, heating and ventilation, sanitation and water supply are usually regulated in some manner by statutes and the public accept what is stipulated by competent authorities without question. Artificial lighting is a necessity in modern life and its effect upon human welfare is of major importance. However, except in a few places where codes are in force, its application is left to the mercy of any individual who aspires to sell lighting equipment.

Good lighting is the most valuable aid in preserving sight and thus forestalling the physical ills caused by eyes rendered defective through faulty lighting.

To the manufacturer, merchant and employers of labor generally it has a decided economic value. Under poor lighting an employee cannot do as much nor as good work as under better lighting. With poor lighting in a store a merchant will not sell as much merchandise as he would under adequate lighting. In night sports the players are more critical about the quality of the lighting than they are about the lighting under which their livelihoods are earned. In a different sphere the lady of the house is most critical of the way light is used in her home. The home is an expression of her personality and the lighting must create the impression that she has in mind. The children go to school to be prepared for the serious phases of life and if the lighting at school is not good they cannot learn as readily nor as well as they should. If the lighting at home where they study their home work is not good their eyes may be seriously handicapped for life.

Is it any wonder that practically everybody takes an interest in lighting? On the other hand, why has there not been more progress made in its application when its benefits have been so well established?

Users of light generally have not learned to think of illumination in measurable quantities. As a result, until they can be shown lighting in a quantitative manner it is difficult for them to comprehend the significance of different levels of illumination intensity.

For many years we have had accurate optical instruments for measuring illumination quantities but they require operators skilled in their use. To the layman the measurement of light has always been a mysterious affair but with the coming of the simple photo-electric foot-candle meters that are being used so widely the act of measuring illumination intensity is so simple and so definite that it immediately arouses the beholder's interest. He can move it around and see for himself how the

intensity changes from place to place. Incidentally, when the meter scale is divided into zones representing different classifications of illumination, it enables him to see for himself in what grade his own lighting falls.

A man will take more interest in the heating of his home when there is a thermometer to consult. Anybody can read a thermometer and know what its indications mean and there is a natural tendency to be guided by it. Artificial lighting does not vary from hour to hour as the temperature may but with an instrument on hand that will measure illumination intensity as easily as a thermometer measures temperature, it enables a lighting salesman or a utility representative to reveal to a client the condition of his lighting in a very convincing manner.

It is gratifying to note the new interest in lighting shown by those throughout the Hydro Systems that have purchased foot-candle meters and the following suggestions are offered as a guide to their use.

The method of using the instruments depends upon the nature of the lighting problem. In stores the tops of counters are generally the most important and the meter placed there measures horizontal illumination. It is often necessary to have illumination on goods on shelves or in display cases along the walls. In this case the meter should be placed so that the eyes face it the same as they would face the merchandise. In this case vertical illumination, or practically so, will be measured. Although not strictly correct, the illumination on a horizontal plane is commonly spoken of as horizontal illumination, and that on a vertical plane as vertical illumination.

In offices, desk tops require horizontal illumination, typewriter desks require both vertical illumination for the copyholder, and horizontal illumination for the machine itself. In factories, horizontal illumination is required for benches and at various angles on machines according to how the workers view the work. In open areas where workers are not definitely stationed at particular locations, measurements should be made at 2½ or 3 feet above the floor and at regularly spaced test stations so as to get the average intensity over the area.

Tables of illumination intensity usually state average horizontal illumination on the work plane, the height of which depends upon the nature of the work, usually 2½ feet for desks and 3 feet for benches. Regardless of the average illumination, if the employees do not have sufficient intensity for their particular tasks the lighting is at fault.

Most work is done on surfaces that are practically horizontal or sufficiently near to it that light that is predominently downward will fulfil the requirements. In any such system there will be a fair amount of illumination on vertical surfaces. However there are cases, of which typewriting is a good example, where high intensity lighting is needed on the copy holder which is practically vertical. There are many stenographers working with atrocious lighting in otherwise well-lighted offices due to unsuitable units or badly placed desks for this particular purpose. In surveying lighting conditions, it is necessary to look for such situations, other-

wise serious faults may be overlooked. It is the light upon the work that counts.

Lay the meter on a manager's or a superintendent's desk late on a dark afternoon and let him read the intensity. Do some experimenting in your own home. Sit down as you would to read and place the meter on the page. When the children are studying their school work lay the meter on the paper or book and note the result. Also look for glare. Measure the intensity where the lady of the house does her sewing, then refer to the requirement for sewing. Sewing is a very severe task on the eyes. Thirty-foot candles or over are needed on light goods, many times that much are needed for darker materials. Homes are notoriously under-lighted and there is a tremendous field for increasing the use of lamps, benefitting both the user and your utility.

When comparing the effectiveness of different lighting units a great deal of caution is necessary to avoid faulty conclusions based upon measurements that do not represent the true conditions. The same lamp should be used successively in the different units and voltage measurements should be made at the same time as the illumination measurements, and if voltage differences are found, correction should be made to the illumination measurements. Figure 1 shows the variation of lumens with voltage from which the corrections can be calculated.

Illumination measurements should be made at systematically arranged points spread over an area sufficient to cover the required spread from the outlet.

It has been the practise of some unscrupulous transient salesmen of lighting equipment to make one measurement directly under a unit. A cheap piece of white glass blown thin on the bottom or with a crystal glass bottom will produce a high reading directly below the unit and usually the lamp used is a very short life, high efficiency one and often high in watts as well. By means of such a combination it is possible to obtain a higher reading with a supposedly 150 watt lamp in cheap glass than with a standard rated 200 watt lamp in a high grade enclosing glass or reflector particularly when the latter are designed to produce a desirable spread. Uniformity of illumination is usually a valuable attribute and it is the rays farthest from those that are radiated downward that contribute to uniformity and also supply vertical illumination for typewriter copyholders, wall and filing cases. A high reading directly below a unit may indicate undesirable characteristics rather than otherwise, except in unusual situations. For most applications of direct lighting a high reading is desirable at a point out from below the unit about 1¾ times the height the unit above the work plane. Where there are two or more units, measurements should be taken midway between adjacent ones as well as directly under. This does not imply that such a method will adequately reveal the relative merits of different units, but is suggested as a means to detect such fraudulent practice as described at the beginning of the paragraph.

Foot-candle meters measure foot-candles only. The intensity in foot-candles is equal to the candle power in

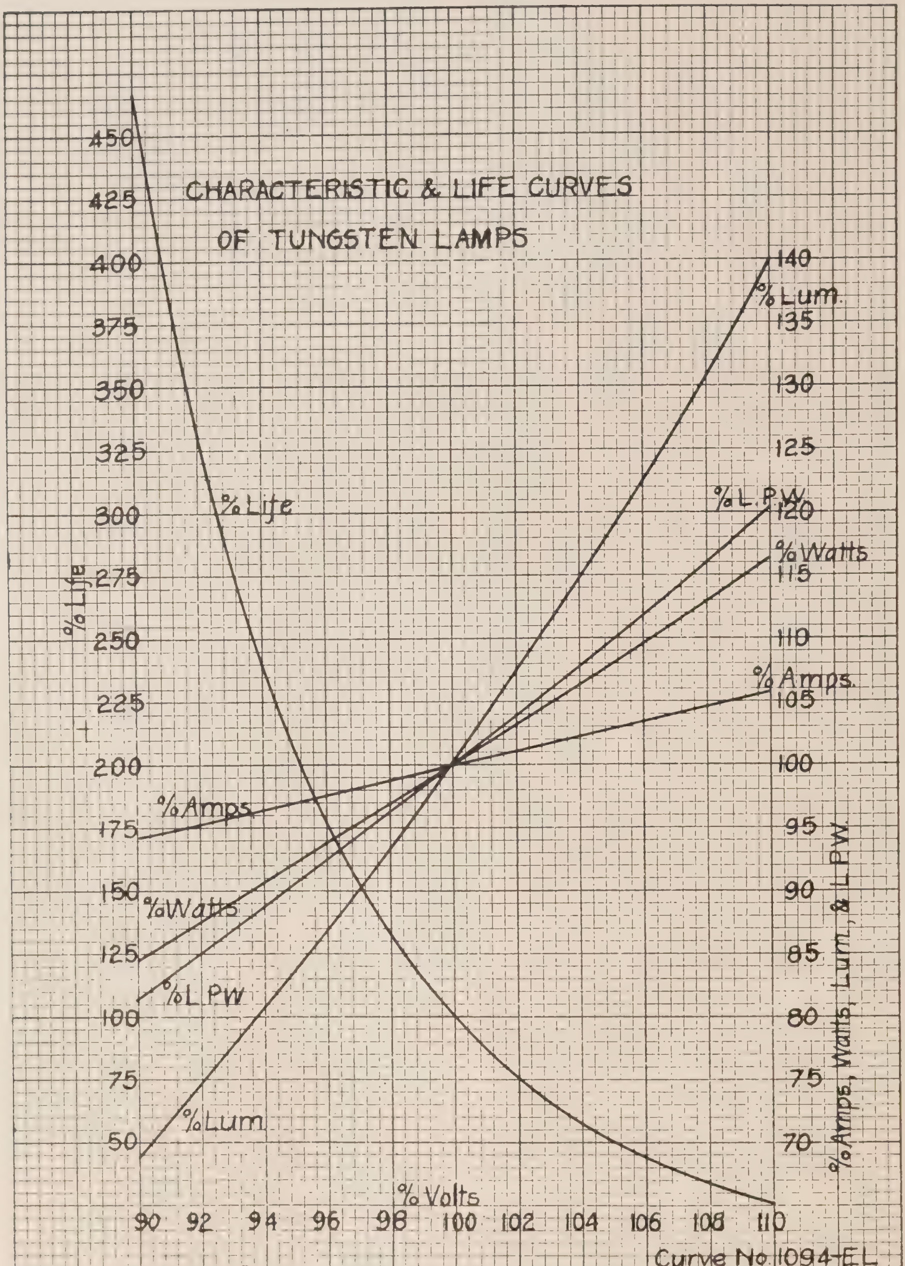

CHARACTERISTIC & LIFE CURVES
OF TUNGSTEN LAMPS
% Life
% Lum.
% L.P.W.
% Watts
% Amps.
% Amps.
% Watts
% L.P.W.
% Lum
% Volts
% Amps, Watts, Lum, & L.P.W.
Curve No 1094-EL

*Fig. 1.*

the direction measured, divided by the square of the distance from the light source to the cell surface of the meter when the surface squarely faces the light source. Consequently the candle power may be calculated by multiplying the foot-candles by the square of the distance, always taking care that the light from the unit is perpendicular to the surface of the photo-electric cell of the meter. For measurements of candle power the distance should be about 10 feet if possible.

A word of caution is necessary regarding the measurement of coloured light. Unless the photo-electric cell is provided with a suitable colour filter it will give higher readings for yellowish light than for bluish light which are of the same value when measured by the eye. For ordinary light from uncoloured tungsten lamps they are sufficiently accurate for all ordinary purposes.

The time of the year is fast approaching when there will be an increased use of artificial light. In every district there are many places where the lighting is of decidedly sub-standard quality and it does not require a foot-candle meter to reveal the fact. A representative from an electrical utility armed with a meter and some knowledge of the intensities required for different uses can be of valuable assistance in promoting the cause of good lighting. Illumination intensity is not the only criterion by which an installation is judged, but sufficient intensity for the various requirements is necessary at any rate and it forms the simplest and most important basis for a discussion of the subject. Briefly stated the requirements are as follows:

Under 5 ft. candles not much good for interior lighting.

5-10 for interiors where close work is not done.

10-20 for stores, offices and simple visual tasks.

20-30 for moderately fine work on light surfaces.

Above 30 for tasks demanding observation of small details and work on dark surfaces.

The Commission's illumination laboratory is at the service of all users of Hydro power. Inspections and surveys of existing conditions will be made and lighting plans submitted when desired. The managers of the local utilities are invited to make use of this service.

## Helping Bakers Sell Cakes

The commercial bakery wants to sell more bread and cake. Can we as electrical men help him do it. A number of utilities are attacking the problem of bake oven sales on just that basis. Women, it seems, are suspicious of the quality of bakers' cakes. By putting the bake oven right out in the show window and letting the prospect see the quality ingredients, cleanly preparation and precision results, customers are led to buy bakery cakes and pastries.

Of course it turns out that no one would put a hot and perhaps dirty fuel-fired oven in the show window, and so the electric utility gets the load.

—*Electric Light and Power.*

# Vibration in Transmission Line Conductors

THE introduction of longer spans and higher mechanical tensions in transmission line cables has resulted in some damage to individual wires of the cables due to fatiguing vibrations set up by lower velocity winds. Occasionally tower members are damaged and bolts and nuts loosened. The presence of these vibrations has been known for some time;—as a matter of fact, nearly everyone has heard the singing of the much lighter stressed telegraph wires on a quiet frosty morning or evening,—but it is only since stringing tensions and diameters of electric cables have been so increased in recent years, that damage to the conductors has resulted.

Usually the damage is done at or very close to a suspension clamp or a pin type insulator. The resulting fractures are more or less perpendicular to the axis of the wire, with no elongation or cupping as in a ordinary tension break. These perpendicular fractures are generally regarded as typical fatigue failures.

This problem of eliminating mechanical losses is for the present being attacked from six directions:

(*a*) Control and limitation of energy imparted to the conductor by the wind through such means as special sections and shapes of conductor, and the introduction of either frictional or lubricating materials, thereby altering the energy dissipation characteristics of the cable.

(*b*) Reinforcing the cable at and near the points of support where the damage is done.

(*c*) The introduction of suppressing or absorbing devices, as in automobiles, by which the energy associated with the vibrations is either broken up to such a degree that they may be expected to cause minimum damage to the essential parts of the system; or absorbed by the mechanism rather than by the individual wires of the cable.

(*d*) Improvements in the endurance limits and physical characteristics of the materials used in the cables.

(*e*) Reduction of the mechanical work expected from the cable so that it is within the limits of the mechanical strength of that material.

(*f*) Forced interference of natural vibrations within a system so as to secure neutralization.

The Hydro-Electric Power Commission of Ontario has appointed a Committee of its engineers to ascertain facts bearing on the problem. The Committee is anxious to facilitate co-operative effort along all such lines and to hear from employees and other interested parties having ideas by way of suppressors or other devices or means for the elimination of this condition. Interviews and discussions of the subject can be arranged by addressing Mr. F. A. Robertson Secretary, Research Committee, Hydro-Electric Power Commission, 620 University Avenue, Toronto, Ontario.

# The Story of Electricity

THE June number of *Power* marks the fiftieth anniversary of that publication and has been devoted to the past, present, and future of power generation. In his editorial, Philip Swain says in part—

"To-day, thanks to modern energy technique, many millions of horsepower flow constantly to machines that do man's instant bidding—carry him through the sky, over land, over and under the ocean—free him of practically all the heavy labour involved in the production of countless necessities and luxuries. Thanks to power alone, man is at last physically free after a million years of slavery to his own muscles."

"The Story of Power", as told by E. J. Tangerman, begins with man, who "countless thousands of years ago, *was* power. Though he was weaker than most animals, he survived them because he learned to apply simple principles of conversion to what power he had available". The different sections of Mr. Tangerman's "Story" traces successively the development of power by different "prime movers" taking in order slaves, animals, wind, water, steam, oil and gas and electricity.

The discoveries recorded regarding electricity as outlined are set down in the following in chronological order.

*585 B.C.*

Thales of Militus, Greek Mathematician and Philosopher, first wrote of amber, when rubbed attracts small bits of shaff.

Aristotle explained about the same time that lodestone (magnetite ore) "has a soul, since it moves iron".

*400 B.C.*

Euripides first called the pieces of lodestone "magnets" because the city of Magnesia produced the best ores.

Susruta, Hindu physician of Thales' time, described early surgical use of the magnet.

Plato talked of its power to attract iron rings and to impart a lesser power to the rings.

*286-272 B.C.*

Theophrastus decided that amber and lodestone belonged together because both attracted other materials.

*100 A.D.*

Senaca, the Roman, talked of lightning, thunder and St. Elmo's fire.

Pliny and Aristotle spoke of the torpedo, a strange fish which shocked those who touched it.

Plutarch recorded that "iron drawn by stone often followed it, but often also is turned and driven away"—the first differenciation between magnetic poles.

*1180*

Alexander Neckham, English monk, discussed the mariner's compass, known to the Chinese.

*1269*

Petrus Perigrinus wrote on the same subject and with Carden and Bishop Wilkins thought of using magnets to produce perpetual motion.

*1489-1564*

George Hartman first discovered magnetic dip and its variation.

Columbus noticed magnetic declination.

*About 1576*

Robert Norman deduced that the earth was really a huge magnet and that the magnetic and geographic poles were the same thing.

*1600*

Sir William Gilbert cleared up most of the mystery and false ideas up to that time. He adopted the word "electrics" from the Greek for amber. He proved Neckham's assertion that a suspended magnet always points to the north; that when a magnet is broken each part becomes a separate magnet; that methods to produce perpetual motion with magnets was unsound; and that an iron particle becomes magnetized before it touches a magnet, its induced polarity being opposite to that of the magnet.

Nicholaus Cabaeus, 25 years later, corrected some of Gilbert's mistakes or omissions and pointed out that "electrics" might repel objects as well as attract them.

*1663*

Otto von Guericke, Burgomaster of Magdeburg, developed the static generator. He rotated a ball of sulphur with one hand and rubbed it with a piece of silk in the other.

*1675*

Robert Boyle showed that a vacuum did not affect the power of magnetism. He also first noticed ozone which he considered the odour of the "electric". Jean Picard reported about the same time a peculiar glow in the top of his barometer tube, when the column descended more rapidly.

*1700*

Jean Bernouilli explained that the tube had to be very dry and the mercury very pure to get the glow.

*1705-1711*

Francis Hawksbee built a static generator using an exhausted glass globe instead of sulphur and obtained light so bright that it lit the room and permitted large print to be read easily. Later, Grey and Wheeler experimented with electrification at a distance using various materials for transmission and supports and from the results showed that "Apparently materials were not only electrics or non-electrics, they were also insulators or conductors."

*1729-1730*

Grey and Wheeler transmitted static charges through silk suspended hemp and silk suspended wire. Meanwhile Charles Francois d' Asternay Dufay in France discovered that electrified gum copal, Spanish wax and amber all attracted gold leaf while glass repelled it. If glass was rubbed with silk, "vitreous" electricity was produced and if amber, rubber, sulphur, or resin were rubbed with fur "resinous" electricity was produced. Soon "vitreous" became "positive" and "resinous" became "negative", the terms which are still used.

*1736*

Andreas Gordon, a Scotch monk teaching at Erfurt, Germany, made a star of sheet metal pivotted at the centre, with the points bent over to one side. When a wire from his static machine was presented to a star tip, a spark would jump and the star would begin to spin from the reaction —the first electric motor. He electrocuted birds with the sparks, most efficiently. It worked just as well to light alcohol and to fire guns.

*1745-1748*

Bishop Von Kleist of Camin, Pomerania, and Pieter Van Musschenbroek of Leyden, Holland, independently tried to store static electricity in glass bottles filled with water. Pieter's experiments received the better publicity, hence the Leyden jar.

Sir Wm. Watson and Dr. John Bevus covered half of the bottle inside and out with tinfoil. Experiments were begun to find out how big a charge could be gotten from a Leyden jar, how far it would travel and how long it took. The discharge began to be used in the treatment of some forms of illness.

*1746*

Dr. Spence journeyed from Scotland to Philadelphia and showed his Leyden jar to Ben Franklin. Franklin discovered the inner coating positive and the outer negative and that the electricity was stored on the surface of the glass and not in the tinfoil.

*June, 1752*

Franklin performed his kite experiment proving lightning and electricity the same thing.

*1787*

Curate Abraham Bennet of Wirksworth designed the electroscope.

*1785*

Dr. Luigi Galvani of Bologna was working on the nervous system of a frog and while cutting into the frog's leg muscles touched a wire attached to his friction machine with his probing scapel. Promptly the frog's legs kicked.

Two years after Galvani's death Volta got the same kick from a pile of alternate copper coins and zinc disks separated by moist cloth. Later Volta used sulphuric acid instead of water to increase the flow.

*1800*

Nicholson and Carlisle decomposed water using a pile of 36 half crowns with zinc disks separated by paper soaked in salt water.

*1802*

Sir Humphrey Davey used a 2000 couple pile to light an arc.

*1819*

Hans Christian Oersted, a Dane, while demonstrating how a fine platinum wire would glow when connected across the terminals of a battery, moved a small compass under the wire, and the compass needle reversed.

*1820*

Andre Marie Ampere was present when Oersted's discovery was announced to the French Institute on September 11th. Seven days later he had answers to most of Oersted's questions. He told the Academy: Two parallel wires carrying current attract each other when the currents in both flow in the same direction, repel otherwise. A coil of wire with a current passing through it acts exactly like a permanent magnet. A bar of soft iron can be magnetized if thrust into such a coil. He also gave the rule for the deflection of the compass needle under the influence of a current.

*1827*

Georg Simon Ohm discovered that the flow of electricity in a wire depends on the difference in potential between its ends and that when the difference in potential was held constant the flow of current varied inversely with the resistance of the wire, Here was Ohm's law.

*1825*

Sturgeon found that a round iron bar placed within a solinoid acquired a magnetic strength many times that of the solenoid alone and lost it as soon as the current was turned off.

*1830*

Schweigger produced the galvanometer.

Daniell developed a battery capable of giving a steady current for some time.

*1831*

From experiments and studies he had been conducting since 1821, based on Oersted's discoveries and Amperes explanations, Faraday had become convinced of these three great electrical laws:

Under the influence of electricity a wire will rotate around the pole of a magnet. If the wire is fixed and the magnet free, its pole will rotate about the conductor. Direction of rotation is reversed in either case if battery connections are reversed.

Electricity obviously produced motion. He wound two separate coils of wire about a soft iron ring, one coil in circuit with a battery, the other with a galvanometer. When he closed or opened the battery switch the galvanometer needle promptly jumped, but it came to rest again. Induction depended on starting and stopping of current as well as on propinquity of coils. (The transformer was not developed until fifty years later.)

Faraday connected his coil to a galvanometer and thrust a bar magnet quickly through it. The needle flickered. The conductor had to cut the magnetic lines of force. He next took a 12 in. disc of copper 1/5 inch thick and mounted it on a shaft between the poles of a horseshoe magnet. Wires from his galvanometer lead to brushes touching the edge of the disc and the axle. When the disc was rotated there was a constant deflection of the galvanometer needle. (The dynamo was perfected forty years later.)

*1832*

Hippolyte Pixii produced a machine having two permanent horseshoe magnets rotate about the ends of two coils of wire mounted on a soft iron core. This gave a.c. He used a commentator to get d.c.

*1841*

Wheatstone replaced the permanent magnets with electromagnets.

*1848*

Brett suggested that the current from a permanent magnet machine be sent through coils surrounding the magnets in order to increase output.

*1849*

Pulvermacher proposed laminated cores.

*1851*

Sinstenden proposed that the current from a permanent magnet machine be used as excitation for the field coils of an electromagnet machine —the birth of the separate exciter.

*1855*

Hjorth patented a dynamo with both permanent and electro-magnet field poles, probably the first self-excited machine.

*1866*

Wheatstone invented a self-exciting machine using residual magnetism to start excitation.

*1872*

Von Hefner Altneck invented the drum wound armature with commutator.

*1873*

Z. T. Gramme had set up two dynamos side by side at the Vienna Industrial Exposition. One was already running; the other had not yet its drive shaft connected. A sleepy workman thoughtlessly connected wires from the moving machine to the one standing quiet and the latter started. Gramme realized that a dynamo and a motor were the same thing.

*1881*

Thomas Alva Edison exhibited a bi-polar dynamo at the first electrical exposition in Paris, the first of the famous "Jumbos". It weighed 27 tons and could light 1,200 lamps. The armature alone weighed six tons.

*1882*

The first central station, having two Edison machines supplied a 3,000 lamp lighting load at Holborn Viaduct in London. The Electric Lighting Act of that year killed the plant in favour of gas lights.

The first Hydro-electric plant was started in Meisbach, Bavaria, which sent current over iron wires to Munich. Soon after America's first Hydro-electric plant was started at Appleton, Wis.

*1881-1883*

Tesla developed and built a brushless motor.

Gibbs and Gaulard took Faraday's idea of two coils wound on a soft iron ring and made of it what they called a secondary generator. They found that the higher the voltage in a transmission line, the more efficiently the current was transmitted, thus with a "step-up" and a "step-down" transformer at the ends of a line longer transmission distances were made possible.

## An Appreciation

THE AMERICAN OPTOMETRIC ASSOCIATION INC.

FARIBAULT, MINNESOTA
August 14th, 1934.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO,
620 University Avenue,
Toronto, Ontario, Canada.

Gentlemen:

I was indeed pleased to note in your copy of the May 1934 issue of THE BULLETIN that splendid article entitled, "Let's See".

This article contains a wealth of information by one of the foremost authorities and best writers on this subject. Interested in making the public eye-conscious and enhancing of the sight and visual welfare of the general public, the American Optometric Association is indeed pleased to note the interest of the Hydro-Electric Power Commission of Ontario in publishing this article.

Sincerely yours,
(*Sgd.*) ERNEST H. KIEKENAPP,
*Secretary.*

# Bright Annealing of Metals

## Advantages of Electric Furnaces

**By John Dummelow, M.A. (Cantab.)**

ONE result of the increasing stringency of specifications of engineering materials and metallurgical products during recent years has been the evolution of heat treatment methods that ensure exact physical characteristics. It has been proved in many large installations that electric furnaces enable any programme of heat treatment to be carried out with greater certainty than fuel-fired furnaces. Not only is the heat applied more uniformly to all parts of the charge, but also the temperature can be so accurately controlled that laboratory precision is obtainable under ordinary works conditions. In addition, the electric furnace can ensure a shallow temperature gradient, which is particularly desirable with miscellaneous charges such as heavy and light castings or pieces of varying sizes if the light thin sections are not to be overheated while the heat is "soaking" through the heavier sections.

These conditions are, of course, a pre-requisite in all branches of annealing (i.e. reheating followed by slow cooling), whether employed in order to soften and eliminate brittleness after hardening, to remove strains set up by cold working, rapid cooling, or unequal heating, or to refine the crystalline structure. In late years, however, a demand has grown up for a process that will give a bright finish without the scaling and oxidisation that are inseparable from ordinary annealing. Such a finish would economize material and save expense in pickling, drying and cleaning, the final product would be more uniform and precise in its dimensions, and for some purposes the finish itself would be preferable to the somewhat etched effect caused by pickling.

In bright annealing the primary consideration is the control of furnace atmosphere. In order to obtain a bright scale-free finish, the material must be protected from oxidisation by atmospheric oxygen, carbon dioxide and water vapour, during the annealing process; incidentally with steel an oxidising atmosphere may also have a decarbonising effect that produces a soft surface and is as harmful as scaling. With fuel-fired furnaces (except in the true muffle type, which has the disadvantage of heavy maintenance costs), the products of combustion make it very difficult to control the atmosphere to any precise degree. With the ordinary electric furnace, though the composition of the furnace atmosphere is independent of combustion requirements, a small amount of free oxygen is present—even in a well sealed furnace—so that a slight scale is inevitable. In the past a bright finish of high quality has only been obtainable by methods that were both expensive and inconvenient. If the pieces are packed in heavy boxes filled with borings, the box and borings absorb a considerable amount of heat and increase the cur-

rent consumption, and packings of sand, ground mica, or other solid inert refractory material (or finely graded and heat-treated anthracite mixed with finely divided talc) are sometimes substituted. If the charge is enveloped in an inert gas such as hydrogen or a mixture of hydrogen and nitrogen, the maintenance of gas-tight enclosures present special difficulties.

A satisfactory solution to the problem was eventually found in the discovery that material heated in a closed chamber can be bright-annealed, by protecting it thoroughly against oxidisation during the cooling period only, and this method has been commercially utilized in the Grunewald system. The annealing pot is sealed and made airtight on the principle of the fruit-preserving jar before the cooling period begins; the covers used are very light, and borings and packings are eliminated. A thorough and uniform anneal with a bright untarnished finish is obtainable at a low cost (little more than for plain annealing) without the need for skilled labour or supervision, and the costs of materials and wages are reduced by the elimination of subsequent processes (due to the absence of oxidisation and scaling) and by the more accurate and uniform dimensions of the product. The high quality anneal produced by this method, which is actually simpler to operate than the ordinary process of plain annealing, has even caused it to be adopted in cases such as chains and engine pistons, where a bright finish is either not required or is of secondary importance.

The Grunewald system can be applied to almost all commercial metals and alloys except brass. It is particularly suitable for treating coils of strip or wire, fine wire on spools, chains, and small parts of iron, steel, nickel, copper, phosphor bronze and other non-ferrous metals; it is also used for cylinder pistons in Diesel engines, coinage blanks of nickel alloy and so on.

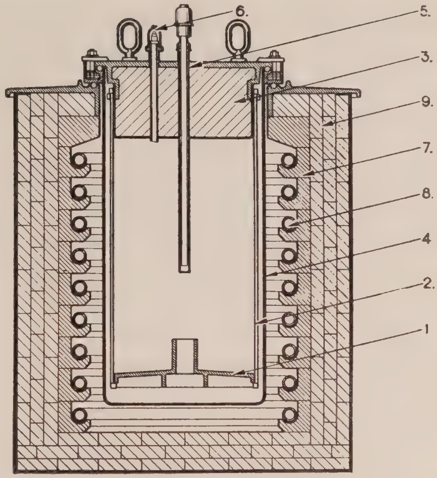


*Fig. 1—Diagrammatic section of G.E.C. electric furnace for bright annealing.*

A cylindrical electric furnace of the resistance type is employed, one of a number in successful operation in this country being shown diagrammatically in Fig. 1.

It consists of a casing of a mild steel, which is provided with heat insulation (9) and a firebrick lining (7) carrying the elements (8). An annealing pot (4) made of a heat-resisting alloy is suspended from the top of the furnace, and the charge is carried on a circular cast baseplate (1), which hangs from vertical rods (2) of nickel chromium inside the pot. The charge may consist of coils in stacks, small parts in light metal pans or baskets

that are annular in plan, or cylindrical objects of all sorts provided that a space is left in the centre of the pot to accommodate the pyrometer sheath (5) containing the thermo-couple. The cover (3) is thermally insulated and provided with an air outlet valve (6), a rubber sealing ring to exclude air from the interior, and lifting bolts. The switchgear consists of the usual automatic control panel with a time-switch and also a pyrometer for measuring the temperature in the centre of the charge.

Such a furnace is usually installed partially sunk in the floor of the shop. As the pot with its contents is heated, much of the air is expelled through the valve, due to expansion; the vaporisation of oil or grease adhering to the charge from previous operations consumes the oxygen content of the remaining air, and the initial pressure decreases until towards the end of the the heating operation, the valve closes automatically and can be screwed down. No atmospheric oxygen can remain in the pot at a temperature at which oxidisation is possible. As soon as the temperature in the centre of the charge equals that outside the pot (showing that the former is uniformly heated throughout) the pot is lifted out of the furnace, and the charge cools in a partial vacuum with no fear of oxidising or scaling. When cool enough the charge can be bodily lifted out on the baseplate, leaving the cover, pot, and suspension rods free for further use. For a one-ton furnace treating coils of steel strip, typical temperature curves taken outside the pot and in the centre of the charge during the heating process show that uniform annealing in every part of the charge can be ensured if the process is carried on for a sufficient length of time. For steel periods of 3½ to 8 hours (generally 5 or 6 hours) and for copper 2 to 2½ hours (one charge being usually annealed every 3 hours) are recommended.

When annealing iron, steel, nickel, and their alloys by this method a heat recuperation system should be used to enable the pots to be preheated before passing through the furnace and at the same time to hasten the cooling of pots containing annealed parts. The time taken for a complete cycle will be shortened and the total quantity of material in process reduced; the ratio of output to material in course of manufacture will therefore be substantially improved.

The method of recuperation adopted depends on the space available and other local conditions. In some cases a fan is used to give a definite air current through suitable ducting. One successful method employs an odd number of pots, alternately hot and cold, arranged in a trench and separated by baffle plates; a forced draught fan causes the air to flow through first the top and then the bottom of alternate plates.

Operation and maintenance costs are low. Copper strip and wire are being annealed with an energy consumption of 90-120 kw-hr. per ton; steel strip is annealed at 720-730 deg. cent. at 170-180 kw-hr. per ton (with heat recuperation) or 200-220 kw-hr. per ton without heat recuperation. Since the pots neither carry the weight of the charge nor stand on the floor of the furnace they can be made of very thin material, considerably reducing the current consumption per charge

and shortening the heating period; the capacity of the furnace is thus increased. The cost of pots and covers per unit of output is only a small fraction of that of the heavy steel pots previously used. Pots, covers, and sealing rings can be used for long periods without deterioration; not one of more than 1,000 pots that have been in use for periods ranging up to four years has yet required replacement, and, even if a pot should eventually cease to be airtight, only a small part of it need be repaired. The tops of the covers are almost indestructible. The temperature is automatically controlled within very close limits, and attention is only required for loading and unloading. The relationship between electrical input and heat output is unaffected by secondary considerations such as the admission of air and fuel in proper proportions; a definite rate of annealing is thus ensured.

In the case of brass and other zinc-bearing alloys bright annealing presents difficulties on account of the ease with which zinc volatilises. A "controlled atmosphere" process developed for fine brass wire, such as is used for weaving into cloth, has recently been extended to strip and other heavier sections. Satisfactory results have been obtained with brass wire in a number of large commercial furnaces in Scotland. This method can also be applied to annealing in pots—*The Electrician.*

# Dogs—How to Approach and Handle Them

THE following was written by Frank B. Dole, a celebrated dog fancier, to promote safety of employees of the Consolidated Gas and Affiliated Gas, Electric and Steam Companies.

It was Charles A. Dana, the celebrated editor, who said, "When a man bites a dog, it's news." In many more cases than most people realize, when a dog bites a man it is really the man who causes the biting. Few dog, like few human beings, go out of their way to cause trouble, and when trouble does occur, and a man is bitten by a dog, it is usually because the dog fails to understand that the use of his teeth is not necessary to protect either his master or his master's property. The prime instinct of any dog is to protect, with his life if necessary, those he loves.

No two dogs are alike in disposition any more than are any two human beings. But there are some general rules that can be laid down for any person whose work takes him into houses where there are dogs which naturally cannot read a badge or know at a glance that the visitor has legitimate business on the prem-

ises. One of these is the fact that virtually all dogs will first announce the visitor's presence to their masters by barking. That is, of course, provided they are not taken by surprise. Thus it is well not to approach a dog's domain too quietly. Another important fact is that few dogs will use their teeth unless startled by some sudden motion which they fail to understand or which they construe as a threat to themselves or to the safety of the person and property of their master. If the dog has a chance to give the visitor the "once-over" and the visitor shows by his confident bearing and normal actions that he has legitimate business, the dog will either evidence friendship or content himself with quietly watching what the intruder is about.

Just as many persons resent a slap on the back, particularly from one who is a comparative stranger, so do many dogs dislike being petted until they have made their own introductions. Virtually all dogs relish having their heads scratched behind the ears, but virtually all of them first want to use their keen sense of smell in forming their impressions of the visitor. Thus, before touching a dog, he should be given a chance to sniff the hand that may be offered in the equivalent of a human hard-shake.

A keen sense of hearing is another element in forming impressions for dogs. He places much reliance on the sound of the intruder's voice. If the tone is quiet, confident and friendly, the dog quickly decides that here is a person who is not going to do anything suddenly and means no harm either to himself or those he guards.

Naturally, too, a dog uses his eyes all the time and is suspicious of objects he does not often see, such as unusually shaped bundles, or in the case of repair men or meter readers, tools or flashlights. If these are being swung in the hand, he may think they are intended to strike him. They should be carried under the arm or in the pocket in approaching a dog and not taken out too abruptly on the premises.

There are several general rules which can be observed by everybody called upon to go from house to house and thus encounter all types and sizes of dogs:

Always let a dog know you are approaching by not being too quiet.

Growls and barks are a challenge; accept them as such and show no alarm.

Sudden or unexpected moves are likely to be misunderstood by a dog.

Speak to strange dogs in a confident, friendly voice, not sharply or scoldingly.

Always allow a dog to approach and let his nose aid him in forming his impressions.

A dog should not be touched unless you have met him often enough to establish a friendship.

Make all your movements natural; do nothing that might frighten him.

A dog should be given the impression that your visit is perfectly proper.—*The Au Sable News.*

# Association of Municipal Electrical Utilities

## Minutes of Convention

The thirty-fifth convention of the Association of Municipal Electrical Utilities was opened at the Chateau Laurier, Ottawa, on June 28th, 1934, at 10.00 a.m., with the President, W. A. Catton, as Chairman.

After a few introductory remarks by the President, the Secretary made some announcements regarding items of entertainment.

Mr. C. A. B. Halvorson, Consulting Engineer, General Electric Company, Lynn, Mass., presented a paper on "Sodium and High Pressure Mercury-Vapor Lamps—Their Application for Street and Highway Lighting." Mr. Halvorson illustrated his paper with a demonstration of the various types of lamps referred to by him and also by lantern slides. Discussion followed Mr. Halvorson's paper by Messrs. R. E. Jones, C. E. Myers, T. C. James, H. F. Shearer, and J. F. Thomlinson.

Dr. H. M. Tory, President, National Research Council, Ottawa, gave an address on the "Work of the Research Council." Mr. W. P. Dobson replied on behalf of the Association, thanking Dr. Tory for his address.

The session then adjourned.

On this same morning there was a conference conducted by the Committee on Accounting and Office Administration with Mr. R. M. Bond as Chairman.

Mr. W. E. Wallace, Windsor Hydro-Electric System opened the first subject, "Credits and Collections" by presenting a short paper. Discussion following this paper was by Messrs. G. Appleton, G. F. Shreve, R. E. Garrett, J. C. Johnston, W. G. Hanna, A. B. Manson, Harry Kirwin and I. N. Pritchard.

"Discounts Recharged" was the next subject discussed, those taking part were Messrs. I. N. Pritchard, G. Appleton, J. W. Bayliss, W. E. Wallace, R. M. Bond, H. T. Macdonald, Miss M. Shantz and Geo. Grosz.

Mr. R. Harrison, Manager, Scarboro Township Public Utilities Commission presented a paper "Customers' Deposits". Discussion on this paper was by Messrs. P. B. Yates, R. L. Dobbin, R. M. Bond, J. C. Johnston, Miss M. Shantz, J. W. Bayliss, A. B. Manson and W. G. Hanna.

A paper entitled "Typewriter Billing—Proved and Controlled" was presented by Mr. W. B. Monroe, Municipal Audit Department, Hydro-Electric Power Commission of Ontario. This was followed by a demonstration at the close of the meeting.

Mr. D. B. McColl, Manager, Walkerville Hydro-Electric System, introduced the subject "Co-ordination of Control Accounts". It was moved by Mr. G. Appleton and seconded by Mr. D. B. McColl, THAT the subject of "Co-ordination of Control Accounts" be referred to the Committee on Accounting and Office Administration.—*Carried.*

The conference then adjourned.

At 7.00 p.m. the delegates met with the Ontario Municipal Electric Association for the first Convention dinner, when Mr. C. A. Maguire, President, O.M.E.A., was toastmaster. Musical entertainment was provided by Mr. T. O. Lanctott and his Gatineau Troubadours. Mr. T. J. Hannigan, Secretary Ontario Municipal Electric Association as guest speaker, gave an address on "Incidents During Early Days of Hydro."

The second session of the Convention opened at 9.40 a.m. on Friday, June 29th.

Mr. R. E. Jones, Assistant Engineer, Distribution Section, Electrical Engineering Department, Hydro-Electric Power Commission of Ontario, presented a paper—"Insulator Ties," which was illustrated with lantern slides. Discussion following Mr. Jones' paper was by Messrs. B. Mulholland, J. H. Caster and G. A. Brace.

Mr. R. T. Jeffrey, Chief Municipal Engineer, Hydro-Electric Power Commission of Ontario, gave an address entitled "A Glimpse into the Future," in which he introduced Mr. K. A. McIntyre, Sales Department, Hydro-Electric Power Commission of Ontario, who described two electric homes that had been equipped to show the advance to be expected during the next five years. Mr. McIntyre's address was illustrated with lantern slides.

Mr. O. M. Perry, Manager, Windsor Hydro-Electric System, presented a paper "Load Building through Good Customer and Dealer Relationship."

The Convention then adjourned.

At 2.30 p.m. the ladies attending the Convention were entertained by the Industrial and Publicity Commission of Ottawa, by being taken on a bus drive through the parks and neighbouring district.

That evening at 7.00 o'clock the delegates met with the Ontario Municipal Electric Association for the second Convention dinner. Entertainment following the dinner was provided by Don Romayne and chorus from the Gatineau Country Club.

Beginning at 10.00 o'clock there was a Convention dance.

On Saturday morning, June 30th, the delegates were given a complimentary bus trip to the plant and paper mill of The James Maclaren Company, Limited, at Masson, Quebec.

The Convention register shows a total of 387 delegates to have attended the Convention, being classified as follows:

| | |
|---|---|
| Class "A" | 77 |
| Class "B" | 192 |
| Commercial | 58 |
| Associates | 27 |
| Visitors | 33 |

There were 310 present at the Convention dinner on the evening of Thursday, June 28th, and 290 at that on the evening of Friday, June 29th. About 175 visited the Maclaren plants at Masson on Saturday morning, June 30th. The hotel reported the total party attending the Convention to be about 600 people.

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


*The following appeared in the Rotary Letter of the Belleville Rotary Club for the week of August 20, 1934:—*

## Rotarian John Robert Cooke

"THE tragic accident reported at our meeting last Monday has brought to a premature close the remarkable career of John Robert Cooke, a ROTARIAN long before ROTARY was ever conceived, one of Nature's noblemen, our county's first citizen. He came up from the obscurity of a rural settlement and triumphed over difficulties and limitations to become one of our country's most honoured statesmen. Such a life is an inspiration to us all. The vast throng that assembled at the modest home in the eighth concession of Rawdon, where his happiest hours had been spent, to pay reverence to his memory at the funeral ceremony on Wednesday afternoon, seemed to be moved by a common grief, and a solemn respect for one who had been a neighbour and a friend and a great-hearted public servant. Particularly appropriate appeared to be the noble words of the Psalmist as they rolled up in majestic volume at the commencement at the stately Anglican service for the dead, "Unto the hills around do I lift up my longing eyes", and later came that splendid expression of faith and hope as "Nearer My God To Thee" was sung with visible emotion by the thousands who supplemented the leadership of the choir. And now he sleeps amid the scenes he loved so well and where his memory will be revered by the children and the children's children of those who loved him best because they knew him best."—*Written by* ROTARIAN OWEN HERITY

Five weeks after the fatal accident to the late Honourable Mr. Cooke, Mrs. Cooke, his widow, also passed away. She had been in ill-health for some years, but the shock from the accident to Mr. Cooke, resulting in his untimely end was evidently the direct cause of hastening her death, which occurred September 19, 1934. — Editor

# Toronto Memorial to Sir Adam Beck

ERECTED BY THE

CORPORATION OF THE CITY OF TORONTO

AND THE TORONTO HYDRO-ELECTRIC COMMISSION

IN GRATEFUL COMMEMORATION OF THE PUBLIC SERVICE OF

SIR ADAM BECK, KT. LL.D. M.L.A. WHOSE LABOURS HAVE ENSURED THAT

THE CITIZENS OF HIS NATIVE PROVINCE UNDER CO-OPERATIVE MUNICIPAL

OWNERSHIP SHALL ENJOY THE BENEFITS OF LOW-COST ELECTRICAL ENERGY DERIVED FROM

WATER-POWER RESOURCES TO SERVE THE INDUSTRIAL AND DOMESTIC NEEDS OF THE PROVINCE OF ONTARIO, MCMXXXIV

THIS is the inscription appearing on both sides of the monument erected on University Avenue at Queen Street in the City of Toronto, which was unveiled by Mayor W. J. Stewart on Saturday morning, September 1, 1934.

The statue, which is 13 ft. 6 in. high, is of bronze, mounted on a concrete monolith, on a massive concrete base and sculptured by Emmanuel Hahn. It depicts Sir Adam in a pensive mood, gazing at a stream of water that flows below him, and thinking of how the power that could be derived from the rivers in the Province of Ontario should be brought to the service of all its people. Across the front of the monolith near the base, the words "Queenston-Chippawa" are carved, and along each side, "Niagara, Nipigon, Trent, Eugenia, Severn, Muskoka, Rideau, Nipissing", the names of Hydro-Electric developments and systems brought into being or acquired under Hydro, during the time when he was Chairman of the Hydro-Electric Power Commission of Ontario, from 1906 to 1925.

Attending Mayor Stewart, and assisting with the unveiling and dedication of the Memorial, were T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario; Joseph Gibbons, Chairman of the Toronto Hydro-Electric Commission; C. Alfred Maguire and the Right Reverend Derwyn T. Owen, D.D., Lord Bishop of Toronto.

# Notes on the Work of the Research Committee

WHEN the Laboratories were established in 1913, research was given a definite status in the work of the new department, and to a large extent such problems as required intensive study and research were referred to it for investigation. During the period of its existence, the Laboratories have brought to a successful conclusion a large variety of investigations which have resulted in improvements as well as economies in many phases of the Commission's operations.

Research has not been entirely confined to the Laboratories, however, for in some instances problems of major importance have been studied by other departments using the facilities of the Laboratories at such times as they were required. In other cases, individual members of the Commission's staff have sponsored ingenious ideas towards the solution of some problem or have tendered valuable assistance and timely suggestions in connection with laboratory investigations in which they were interested.

In order to correlate the research work in all departments and to stimulate interest in these activities among the Commission's employees, a Committee on Research was organized early in 1933. This organization consists of the Main Committee composed of five department heads, and a number of sub-committees each appointed by the Main Committee to conduct research in some particular field. The sub-committees are appointed to represent all departments vitally interested in the problem under consideration, and are selected from those members of the staff in close contact with the work. At present there are nine sub-committees having a total membership of about forty actively engaged in typical research projects.

Although in effect less than two years, this system of directing the Commission's research studies has proven very successful in that it has stimulated active interest in all departments and has brought forth many valuable suggestions not only from the committee members, but also from the staff in general who at all times are invited to direct any communications relevant to these researches through F. A. Robertson, Secretary of the Main Committee. By this system the possibility of duplication of work by various departments is avoided, and the talent and experience of all parties interested in a specific problem are combined towards its solution.

### Markets For Power

This important subject has been studied by two sub-committees. The first of these was formed to investigate electrolytic oxygen and hydrogen and to continue studies made by the Laboratories for some years previous. The activities of the Committee have included investigation of the possibility of generating oxygen and hydrogen by means of off-peak or surplus power, and the utilization of these

## CONTENTS

**Vol. XXI** **No. 9**

**SEPTEMBER, 1934**



gases for industrial and other purposes. Proposals made by various members of the Commission's staff have been given attention as well as suggestions and plans submitted by engineers and others outside of the Commission. The importance of this subject lies in the possibilities of consuming immense quantities of power, and it possesses so many phases that intensive study and careful consideration of each of these and its relation to the others is necessary. These proposals have included the use of pure hydrogen as a fuel, the use of electrolytic gases in the production of city gas, the investigation of cells for the production of these gases, the setting up of experimental plants to demonstrate the technical and economic features of the problem, and many other items.

Another Committee was appointed to study soil heating by electricity in continuation of work previously done by the municipal engineers. The object of this investigation is to determine the suitability of electricity for the promotion of plant growth, and to utilize the information so obtained in extending markets for power. The efficacy of electric soil heating has been demonstrated in the past both in this country and abroad, and the Committee's efforts have been directed principally towards co-operating with growers in the demonstration of the practicability of applying electricity to their business. Efforts are also being made to acquire information not now available elsewhere regarding the characteristics of electric hot beds with a view to improving the efficiency of design. Very encouraging results have been obtained and interest in the matter is increasing among growers, so that it seems assured that Hydro power may find an increasing outlet in this direction The committee has estimated that the various applications which it is now studying offer a potential market of over 15 million kilowatt-hours per year.

### Domestic Services

The extension of electric service to domestic consumers often involves enlarging the house wiring so as to accommodate the load to be added. Many houses wired fifteen or twenty years ago before the use of electric heaters, ranges and other appliances had reached appreciable proportions, now require additional and enlarged wiring. An important element in this additional cost is often the service and the cost of services as ordinarily installed is often responsible for deterring the householder from increasing his use of electricity. A sub-committee of the research committee made a

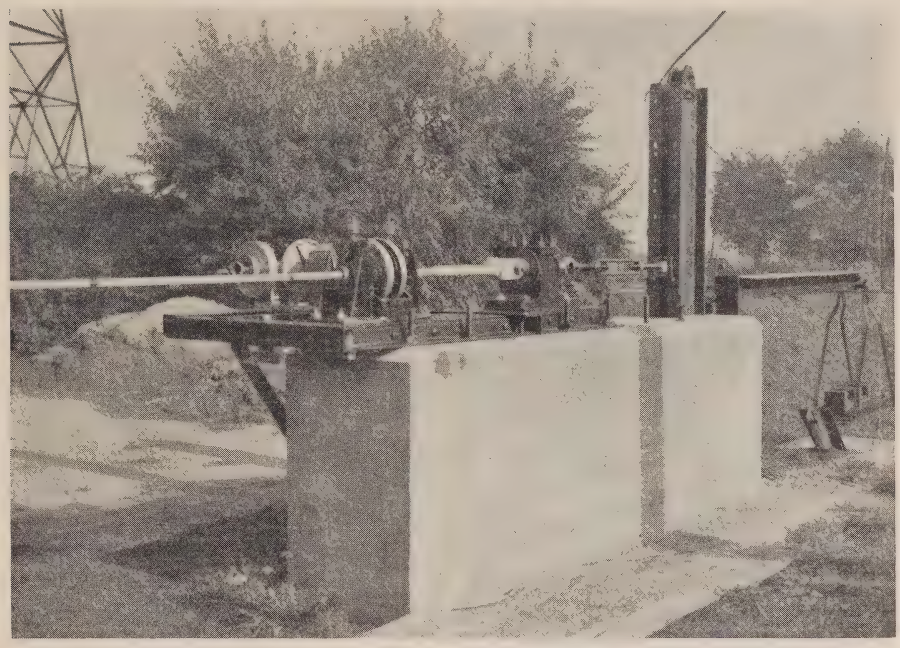


*Fig. 1—Vibration Equipment for making Laboratory Tests on Rural Dead-end Clamps and Connections. Seven conductors made into a composite cable are vibrated by means of an eccentrically weighted fly-wheel mounted directly on the cable. Frequency is varied by adjusting a friction drive and constant tension is maintained by weighting the lever arm shown in the background.*

thorough study of this problem and was able to devise an arrangement of service equipment which will make a very great reduction in the cost of installing services.

### Heating Elements

The efficiency and life of electrical appliances is a matter of great importance to the Hydro customer and to the Commission. The committee undertook a study of this following complaints received by various municipalities that the life of heating elements, particularly in ranges, was low, that the expense of replacing elements was too high and that, in general, the cost of repairs to these appliances was excessive. Based upon answers to a questionnaire the sub-committee on heating elements has undertaken a systematic investigation of existing appliances in the hope that with the co-operation of the manufacturers, important improvements in efficiency, life and economy in operation may result.

### Vibration of Line Conductors

One of the first sub-committees to be formed under these new arrangements was that organized to investigate remedial measures for preventing or reducing cable failures caused by transmission line vibrations. This problem has held the attention of

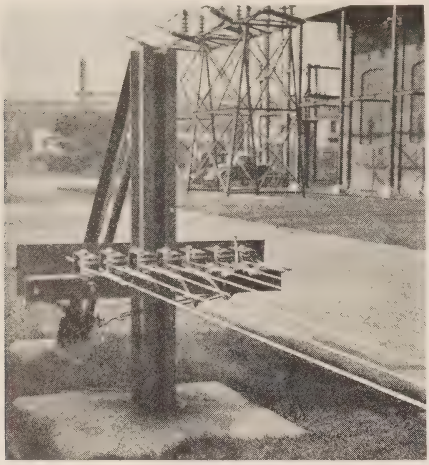


*Fig. 2—Laboratory Tests on Clamps and Connections. This view shows the opposite end of the 150-foot test span shown in Figure No. 1. The seven conductors of the composite cable are fanned out near mid-span so that seven tests may be made simultaneously on one set-up.*

transmission engineers for several years and research laboratories in many parts of the world have devoted a great deal of time towards its solution with only partial success. The sub-committee on vibration has carried on the investigation begun by A. E. Davison and his associates, and at present is attacking the problem from three different directions by investigating cable materials with a view to improving the quality in regard to fatigue resistance, making endurance tests on clamps and connections using a mechanically sustained vibration on a laboratory test span, and making field tests on experimental lines at Islington and Port Credit to determine characteristics of various conductors, clamps and damping devices under actual service conditions.

In connection with field testing, the committee has developed an entirely new method of attacking the problem in that observations are being recorded of single travelling waves induced by hand rather than of the so-called standing waves excited by wind forces which are comparatively infrequent and rather irregular in their occurrence. The Committee has also developed a new method whereby changes in stress are graphically recorded by means of an oscillograph used in conjunction with carbon pack resistors attached to the vibrating cable. This equipment has shown much promise in the investigation and

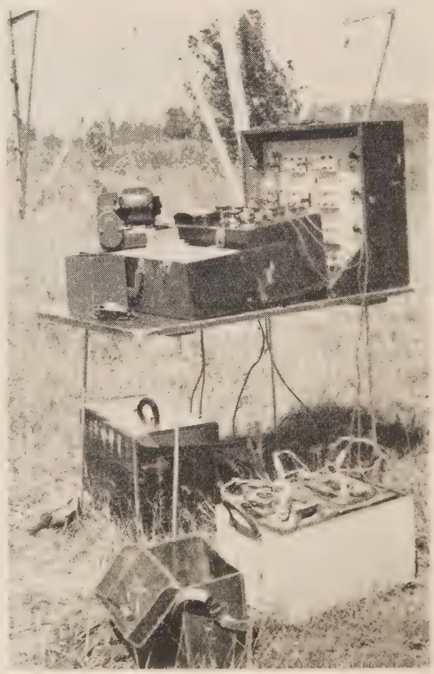


*Fig. 3—Oscillograph and Control Instruments for Recording Transmission Line Vibrations in the Field.*

has revealed many features of vibration phenomena hitherto unobtainable by other means.

### Remote Control of Loads

The Commission's hot water heating campaign has suggested several problems relating to the remote control of off-peak power loads whereby various services may be cut in or cut out from the sub-station. A subcommittee is at present studying several systems proposed by outside organizations as well as one system developed in the Commission's Laboratory with a view to having this information available when necessity dictates the protection of our peak power demands.

### Paint Research

The Laboratory has for many years studied the relative merits of paints used by the Commission, and this work is now being continued under the guidance of the Research Committee. To a large extent this work consists of comparative tests, both in the Laboratory and in the field to determine the most satisfactory products from a standpoint of quality and economy. Each year a report is prepared for the Commission's use containing a complete list of paints found by test to be most satisfactory, and in addition contains recommended practise for their use on various types of work.

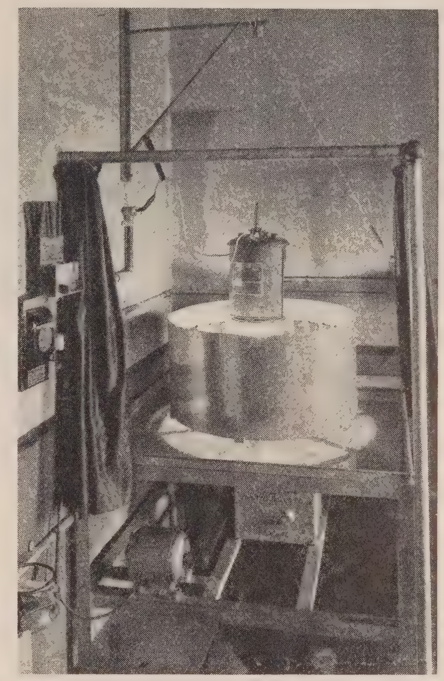


*Fig. 4—Apparatus for making Comparative Tests on Paints. Specimens are slowly rotated about a powerful carbon arc duplicating the effect of sunshine while alternate conditions of rain are supplied by a water spray.*

### Petroleum Products

Another project of considerable importance is that under the direction of the Sub-committee on Petroleum Products. The main problem under consideration is to develop methods whereby transformer oil which, through continual service has become unfit for use, may be reconditioned and restored to many additional years of service. Considerable laboratory work has already been done on this project with complete success, and plans are being made to apply this method on a practical basis.

Tests have also been made on gasoline and automobile lubricating oils which have made possible the preparation of specifications for use by the Commission's Purchasing Department. Further standardization work is in progress in connection with generator lubricants, and studies are be-

*Fig. 5—Test Bed for Wood Poles near Barrie, Ontario. Poles are given various preservative treatments and kept under observation.*

ing made on journal oil for street car service.

### Wood Pole Transmission Structures

The destruction of wood pole transmission structures by ground rotting has been a matter of much concern to power companies for many years, and the Commission has been studying this problem in an effort to reduce replacement costs. The Commission has an investment of approximately $10,000,000 in wooden transmission structures. If five years can be added to the life of these structures, it is estimated that an annual saving of $225,000 can be effected in replacement charges.

Practical tests are now in progress to determine the most effective preservative treatment. At Barrie and Leaside about one hundred test poles representing woods most commonly used have been given various preservative treatments and planted in test beds set aside for the purpose. In addition, over five hundred poles in service representing typical groups from selected districts, have been tagged for inspection. These poles are examined periodically and complete records are kept of their condition.

The Committee is also investigating remedial measures for preventing insect destruction and has been active in preparing specifications for creosote treatment.

Research of this kind must necessarily be carried on over a period of several years, but results of observations already made point to the fact that a large saving will eventually be realized as a result of these studies.

### Conclusion

It may be inferred from the reading of the above notes that the research work of the Commission is directed along eminently practical lines. Little of the work described can be classed as pure scientific research. It is being carried on by engineers engaged with practical operating problems and is directed towards saving money for the Commission by lowering costs and improving efficiency. Its activities embrace the transmission, distribution and utilization of electricity.

Many problems of course have arisen and will arise, of a scientific

character, some of which we may not be equipped to solve. The Research Committee is in a position to co-operate with other research organizations so that duplication of equipment and effort may be avoided as far as possible and results may be obtained in the least possible time.

The Association of Municipal Electrical Utilities has by resolution endorsed research work in the Commission and has urged the Commission to extend it. The Research Committee thus feels that it is carrying on a work of fundamental importance to the Commission, the value of which is recognized by its municipalities.

# Ottawa-Cornwall 110 kv. Line

**By A. E. Davison, Transmission Engineer, Electrical Engineering Department, H.E.P.C. of Ontario**

MAJOR portions of the lines to serve Cornwall and vicinity from Ottawa were placed in service on July 29th, clearing on this line having commenced May 28th. This single circuit steel tower line, some 54 miles long, extends from a point near Ottawa station (Carling Avenue) to the existing transformer station at West Cornwall at which station power has been received from the Cedars' organization since 1919. Power will now be supplied from Ottawa District (Gatineau Power Company supply) both for the existing demands and for new contracts such as that of the Howard Smith Company toward which plant a new wood supported 110,000 volt line, some 2.2 miles long was built from Cornwall station. Power was delivered over this latter short line toward the end of August.

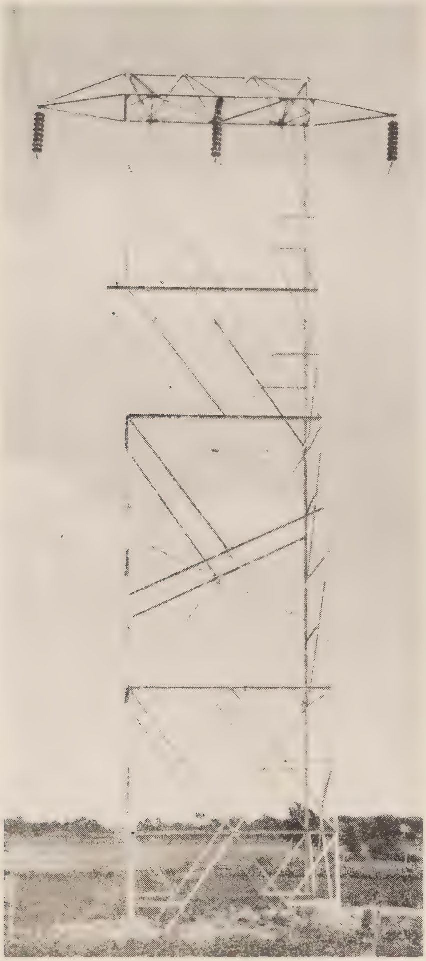
The line already placed in service is of the more standard single circuit steel tower supported type, the details of which can be secured from the list of characteristics below. It is built across country using easement type of agreements with farm owners.

The right-of-way was secured at rates consistent with earlier costs of similar privileges. It was secured in advance of construction to a greater degree than formerly thereby facilitating the construction work materially. Approximately 98 per cent. of the right-of-way, apart from notices of entry, were secured at the time construction work was completed.

This line of towers carries a telephone circuit for the ready maintenance and patrol of the line. The towers are relatively higher than usual for the base used and costs have been reduced to limiting values for the mechanical work to be done by the system. Silicon steel has been used in the main leg members making them appear small for the work they are to do.

Existing facilities were used in carrying the wires westerly from Carling Avenue station and from the nearby junction in such a way as to avoid congested areas.

More than ordinary attention was given to the earthing of the individual structures of this line in an effort to

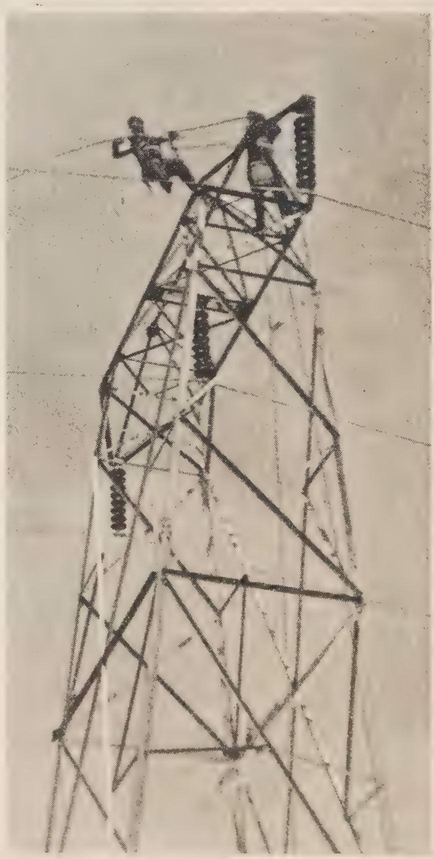


*Typical construction at Ottawa-Morrisburg Highway showing communication wires crossing underneath.*

reduce lightning outages to a minimum.

Few special features were encountered. The Rideau Canal was crossed with a clearance of 45 feet, using a span of nearly 1,000 feet. There was one crossing of a 220,000 volt line near the Prince of Wales Highway where these 110,000 volt wires were carried underneath and there were crossings over the important Toronto-Montreal railway services of the C.N.R. and C.P.R.

Although this line is located in a series of clay flats of the Nation River and other tributaries of the Ottawa, nevertheless rock was encountered to a greater extent than was estimated although it actually occurred in less that 20 per cent. of the footings. In a few cases concrete was added to the steel grillage footings either to im-



*Man in aerial chair securing anti-vibration reinforcement loops to ground wire.*


*Map showing location of Ottawa-Cornwall 110 kv. 60 cycle services. The location of a tie between Ottawa, Smith Falls, Brockville and Cornwall at 110 kv. and 44 kv. is indicated.*

prove conditions and for levelling up where rock was encountered, or to improve uplift and bearing values where the footings were in silt or in bogs.

One thousand tons of materials were transported practically all of which except the steel was made in Canada. Over 125,000 man hours of which approximately 10 per cent. was office and field engineering and inspection, surveys and accounting were involved in a total cost of approximately $325,000.

There were no personal accidents of importance during the construction and practically no lost time on account of accidents. The line was built under excellent weather conditions—that is, during a period of 60 days of June and July, when weather conditions were comparatively dry. About 15 per cent. of the excavations had to be unwatered.

The photographs and plates herewith give some idea of the type of construction, conditions under which the line was built, and location.

## Tabulation of Transmission Line Characteristics
### 110 kv. Line—Ottawa to Cornwall

Length—54.137 miles.
Nominal Span—880 feet.
Maximum operating voltage—110,000 volts.
Frequency—60 cycles.
Date originally placed in service—July 29th, 1934.
Number, type, and location of lightning arresters—At three connected stations, —Cornwall and Ottawa—Val Tetreau.
Neutral—Solidly grounded.

Locations of neutral grounds—Val Tetreau and at Howard Smith Cornwall (steam) T.S. (4 miles from Cornwall T.S.)—Not installed as yet.

Conductors:—

Size and material—No. 0000 a.c.s.r., 6 aluminum wires, 0.188 in. dia., and 1 steel wire, 0.188 in. dia.

Maximum design tension—3,740 pounds (½ in. ice, 8 pounds wind) + 30 deg. fahr. 60 deg. tension—900 pounds.

Equivalent spacing—17.64 feet—flat configuration. Actual horizontal spacing—14 feet.

Maximum sag in nominal span—34 feet 120 deg. fahr.

Insulators—suspension:—

Number of units per string and type—8 units 10 in. by 5 in., ball and socket.

Insulators—dead-end:—

Number of units per string and type—10 units 10 in. by 5 in., ball and socket.

Number of strings in parallel—railway crossing towers have double suspension insulators.

Flashover Protection:—

Suspension—none.

Dead-end—none.

Ground Wires:—

1—5/16 in. crucible steel—4 immersion galvanizing. Practically all towers indicating a resistance in excess of 10 ohms have been equipped with a grounding network of copper, buried about 18 inches.

Location—at top of tower leg approximately midway between and 7 feet above conductors in clamps on suspension tower.

Method of support—suspension clamp with festoon type of vibration dampener.

Supports:—

Type and material—steel towers—carbon steel with silicon steel legs.

Total number in line—335.

Designed for loading of ½ in. ice, 8 pounds wind, 30 deg. fahr. along line, and for ¾ in. ice, 11 pounds wind, 30 deg. fahr. across line at 28,000 pounds, per sq. in. tension.

# The Georgian Bay Municipal Electric Association Annual Meeting

THE annual meeting of the Georgian Bay Municipal Electric Association was held at the Town Hall, Collingwood, on Wednesday, September 12th 1934. There were some one hundred and twenty-five delegates present, representatives of the fifty odd Hydro towns in the Georgian Bay District.

The morning session opened at 11.00 o'clock, when Wills Maclachlan of the Electrical Employers Association of Ontario gave an address on Accident Prevention in Public Utilities. The speaker outlined the results achieved through accident prevention in Ontario and stressed the need of continued effort. Following his address, Mr. Maclachlan exhibited several safety devices and explained the proper use of tools and equipment. He also gave a demonstration in artificial respiration by the Schafer Prone Pressure Method. At about 12.00 o'clock noon, the delegation gathered at the Collingwood Utilities office where W. B. Munro of the Municipal Audit Department of the Hydro-Electric Power Commission of Ontario, explained and demonstrated modern office equipment for use by the smaller municipalities.

At 2.00 p.m., the delegates again assembled in the Town Hall for the main session of the Convention. The meeting was called to order by the President, W. H. Gurney of Wingham. He invited T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario, to a seat on the platform, and upon his arrival introduced him to the assembled delegates who received him with great applause. He also asked R. T. Jeffery, Chief Municipal Engineer, Hydro-Electric Power Commission of Ontario, T. C. James, Municipal Engineer, Hydro-Electric Power Commission of Ontario, and T. J. Hannigan, Secretary, Ontario Municipal Electric Association, to take places on the platform.

In opening the session, Mr. Gurney called on H. E. Prentice, Chairman of the Collingwood Public Utilities, to introduce Mayor D. Williams, who, on behalf of the Town of Collingwood, extended a hearty welcome to the visitors.

Before proceeding with the business of the meeting, Mr. Gurney asked all to stand in silence with bowed heads for one minute in memory of the late Chairman of the Hydro-Electric Power Commission of Ontario, the Honourable J. R. Cooke.

The Secretary, H. S. N. Denef of Hanover, read the Minutes of the previous annual meeting and all subsequent executive meetings, which on motion of David Hurrie of Midland, seconded by John Kalte of Hanover, were adopted. The report of the Treasurer showed a net balance of cash on hand of $35.64.

Proceeding with the programme, J. R. McLinden, Owen Sound, spoke of the building up of reserve funds and of the sale of power to private companies by the Hydro-Electric Power Commission of Ontario. Mr. Lyon

and Mr. Jeffery replied, explaining the matters in question.

John Kalte introduced the subject of peak period and service charges, and also the question of the local Commission being permitted to lend money to the municipality. These questions were replied to by Mr. Jeffery.

The financial situation in Neustadt was introduced by Herman Denef of Hanover, when he suggested that some plan should be devised to correct the condition in Neustadt which has resulted from the loss of considerable industrial load. After some discussion of this matter, Mr. Halliday of Chesley introduced a resolution expressing the sympathy of the Association and asking the Hydro-Electric Power Commission of Ontario to give this matter early and sympathetic consideration.

Dr. Fowler of Teeswater, spoke in reference to water powers of Ontario in general.

The subject of interim rate charges in the Bruce Peninsula was introduced by John Kalte of Hanover. Mr. Jeffery explained the factors that were the cause of the conditions existing in this area.

The election of officers for next year resulted as follows:—

PRESIDENT:
J. R. McLinden, Owen Sound.
FIRST VICE-PRESIDENT:
David Hurrie, Midland.
SECOND VICE-PRESIDENT:
John Kalte, Hanover.
SECRETARY-TREASURER:
Herman Denef, Hanover.
MEMBERS OF THE EXECUTIVE:
C. J. Halliday, Chesley.
J. Carlton, Beeton.
Dr. Marcus, Kincardine.
R. J. Beaulieu, Penetang.
H. E. Prentice, Collingwood.
D. R. Wallace, McTier.
Alfred Menary, Grand Valley.

J. Kalte of Hanover, invited the Association to meet in Hanover next year, which was heartily accepted by the members.

In addition to the municipal delegates and their guests, representatives from a number of manufacturers and wholesalers were also in attendance. These had arranged interesting displays in a room especially provided for that purpose.

Following the adjournment of the meeting the delegates met in the Masonic Temple for a banquet, when the newly elected President, J. R. McLinden of Owen Sound was toastmaster. The speaker of the evening, T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission, was introduced by David Hurrie of Midland. The thanks of the meeting were tendered Mr. Lyon by T. J. Hannigan. Musical entertainment was provided by Miss Maude McTaggart, A.T.C.M., who gave a couple of pleasing vocal solos and responded graciously to hearty encores. The banquet was arranged by the Collingwood Public Utilities Commission of which H. E. Prentice is Chairman, and their successful efforts in this detail were greatly appreciated.

# Credits and Collections

**By W. E. Wallace, Windsor Hydro-Electric System**

(*Introduction of discussion at Accounting and Office Administration Session Association of Municipal Electrical Utilities at Ottawa, June 28, 1934*).

A GREAT deal of our collection problems of the present day can be attributed to the lack of the debtor realizing his responsibility to pay when due and in exact accordance with the original agreement. For this reason I propose to deal with the Credits and Granting of Credit first.

How many creditors take particular care when an account is being opened to stress the point to the customer that his payment is due on a certain date and must be paid on that particular date and if unable to fulfil his agreement it is his duty to arrange for an extension of time at the office. This will eliminate the thought that may be allowed to come to him that he will have it, in a week, or ten days and it will be alright to just let it slide, and often relieves the creditor from sending extra notices and other means of a follow up on past due accounts, and does not leave it open that your customer will have reason for any petty grievances of feeling he is being rushed on his account. This point should be clearly brought out at the time the sale is made and the account opened so that both the debtor and creditor has a distinct understanding of what is expected of each. Some firms use a form letter sent from the Credit Department, shortly after the sale is made expressing appreciation of the business and setting forth the terms of the contract quite clearly. Full particulars of the customers present employment, income, and present monthly obligations should also be reviewed before the deal is completed and many times, much to the surprise of the customer, he finds that he already has obligated himself to more than he has ability to pay and will result in making a friend of him, as he feels you treat his problem with care and confidence and your wish is to help him solve his own situation rather than going ahead and loading him up and then using every forceful means to collect, which results in spending more than your profits and makes a bad friend of one who might, with proper care, become a satisfactory customer. This could be termed as Educating Your Customer and the result is well explained in the phrase, "As a twig is bent so shall the tree grow."

Collections are in a class alone almost and a great deal of trouble arises in allowing the customer to develope the habit of paying when it suits him, rather than when it suits the creditor. To avoid this, it is well to have a set rule and carry it out to the fullest measure, together with a follow up system that will work one hundred per cent. and as soon as the debtor realizes his account is closely watched and when past due it is brought to his attention, he begins to take more interest in it himself. The bad ones at first are the best and easiest handled in the end. The idea is not to be harsh but to have an

objective from which results will be obtained.

Dealing with light accounts, might we just quote our own experience. Less than three years ago, we made few disconnections, the arrears were very high, notices were sent out of disconnection and not carried out accordingly, with the result that their effect on the consumer was lost. The day came when it was necessary to adjust the situation and we started to disconnect on the exact day stipulated in the notice, which caused friction at first but brought results. During 1933, out of an average of 18,000 active meters at no time did number remaining disconnected exceed 70. Our arrears decreased month by month and a comparison of the first five months of last year, with that of this year, shows 400 less disconnects and our accounts are in finer shape. Less work is being done on the accounts, the delinquents are arranging at the office in place of our going to them, which proves the value of educating the customer that the account is his responsibility, not yours.

* * * *

It was shown in the discussion on "Credits and Collections" that in some municipalities, consumers in arrears were disconnected, either at the pole or by sealing the meter. Some utilities, however, considered it more desirable to try to collect arrears and try to keep the service on.

*General view of 220-kv. Switch Yard, Chats Falls Development.*

# Customers' Deposits

**By R. Harrison, Manager, Scarborough Public Utilities Commission**

(*Introduction of discussion at Accounting and Office Administration Session of Association of Municipal Electrical Utilities at Ottawa, June 28, 1934*).

HAVING been asked by the Accounting Committee to make a few observations and remarks on the subject of Customers' Deposits, in order to introduce a discussion, I will briefly outline the system used by the Scarborough Public Utilities Commission. Our Commission realized as early as the year 1921, that it would be necessary to collect from new consumers a guarantee deposit that would prevent the accumulation of large arrears on final bills. A sum of $5.00 was collected from owners and tenants for both 2-wire and 3-wire services. In the year 1925, after receiving complaints from owners of property who had to pay arrears before the next tenant could receive service, and also finding that some consumers with stoves had incurred large final bills, our Commission decided to increase the 3-wire deposit to $10.00. Of course, after the revision of the Public Utilities Act in 1927, owners could not be held liable for tenants' arrears, a fact which made the system of deposits all the more necessary. The population of our Hydro Voted Area is approximately 15,000 and the number of consumers is 4,800—domestic 4,404, commercial 360, power 36,—and the number of deposits is 4,200. The difference between the number of consumers and the number of deposits is explained by reason of the fact that our System took over a number of old Toronto Electric Light consumers, who were not required to pay a deposit, and also, deposits were not taken from power consumers until the year 1929. This is the system in force at the present time in Scarborough, and we find it working very satisfactorily and causes very few complaints, as well as enabling us to keep arrears down to a reasonable amount. Our uncollectible arrears on final bills amounted to less than one-tenth of one per cent. of our total revenue for the year 1933.

Several suggestions have been made as regards points to be discussed. The first one is whether or not deposits taken by a large utility is preferable to the usual collection method. In the writer's opinion it would be preferable for the large utilities to collect deposits. This opinion is based on experience with collections and the deposit system for over ten years. There is no doubt that there are some municipalities where the deposit system may not be necessary due to the fact that the population is more or less permanent. In most large municipalities, and smaller municipalities adjacent to the larger ones, a certain section of the population is transient or floating, and to protect the interests of the permanent customers, it is necessary to have some system whereby final bills can be collected. It is a well known fact that most business concerns have their bad or uncollectible debts, but Hydro is supposed to supply service at cost,

and if this principle is correct, and the system of metering is the right one, then certainly every consumer should be made to pay for the current consumed as per his contract.

Another question for discussion is the matter of interest on deposits—the rate of interest, and when computed, and the refunding of deposits. Our Commission pays 3 per cent. simple interest and it can be collected by the customer as part payment on current bills after the deposit has been in force for five years or more. In Scarborough, deposits are only refunded when final bills are paid. The matter of refunding deposits to customers with good records for a number of years has not been considered, and that practice during these trying times would not be wise, due to the uncertainty of conditions at the present time. Guarantees are accepted in lieu of deposits when the owners will guarantee to pay all arrears left by tenants. It is only necessary to make arrangements such as above in a few isolated cases. A few owners pay the deposit for the tenant, but in most cases they do it only once. It is practically impossible for a utility office to keep its records up to date showing all the changes of ownership of property, and the principle of accepting guarantees should be discouraged.

I trust that the foregoing will be sufficient to open a discussion on the much debated subject of Customers' Deposits.

* * * *

*By P. B. Yates, Manager, St, Catharines Public Utilities Commission.*

In 1914 when St. Catharines started its Hydro System, we started in competition with the local subsidiary of the Dominion Power and Transmission Company and we could not emphasize conditions which would interfere with our securing the business of consumers who were supplied by our competition. When the Dominion Power was taken over by the Hydro and it might have been possible for the two local systems to co-operate on procedure, the late depression was upon us and our Commission decided that it was hardly the time to impose on our consumers an added expense of paying a deposit. We were having trouble enough collecting our current accounts without asking for added payments towards a deposit.

The depression however has shown us that some change of procedure is necessary in order to reduce the expense of collecting accounts and we are very much interested in the Association deciding upon a general policy to be followed by all municipalities, the procedure to be inaugurated as soon as commercial conditions allow.

*Question No. 1*—Are deposits taken by a large utility preferable to the usual collection methods? It is my opinion that deposits are of very little value as actually they only defer the disconnection method of collecting accounts until a certain percentage of the deposit is wiped out by unpaid bills. I prefer the disconnection method of collections ten days after the due date of an account if payment has not been made, this is to be an arbitrary rule to be followed without variation for any reason whatsoever.

*Question No. 2*—Is interest paid on security deposits? If a deposit is made, 5 per cent. interest should be paid.

*Question No. 3*—How often is it computed? My answer to this question would be that it should be credited on the first account following the first of the year for the preceding year or for such part of it as the deposit has been in our hands.

*Question No. 4*—When are deposits refunded? No deposit will be refunded except as a credit against the last account. This however brings up another one of our local difficulties—a consumer who has paid his account and established a credit for the last 20 years would be justified in resenting our action if our procedure were now changed and he be asked to make a deposit.

*Question No. 5*—Are guarantees accepted in lieu of deposits? As we are asking no deposit at the present time, I can only give my opinion as to the recommended procedure if deposits were locally required. The answer to this question, I believe, would depend upon the procedure decided upon in each municipality. If a deposit is required, it should be required from them all. If guarantees are accepted, you are simply placing responsibility upon someone discriminating between guarantors who are good and those which are valueless. If guarantees are accepted, you must continually check up on these.

* * * *

There was a diversity of opinion as to the desirability of requiring consumers to pay deposits, though it was shown that of the Utilities represented, the majority did so. Some utilities allowed interest at the rate of 5 per cent. on such deposits. Although some utilities accepted guaranties they had not been satisfactory. The question of consumers' deposits was referred back to the Committee on Accounting for recommendations on procedure to be followed by the municipalities.

# Typewriter Billing—Proved and Controlled

**By W. B. Munroe, Municipal Audit Department, H.E.P.C. of Ontario**

*(Presented at Accounting and Office Administration Session of Association of Municipal Electrical Utilities at Ottawa, June 28, 1934).*

MUCH work has been accomplished in the larger municipalities in recent years installing mechanical billing equipment to prove the correctness of the calculations and set up the necessary statistical data. With but few exceptions the cities and large towns are enjoying up-to-date billing methods.

Experiments have been carried on during the past year with a view to giving the smaller municipalities balanced billing, and, as far as possible, mechanical operation. We believe that we now have a system which proves satisfactory.

The typewriter with a fourteen-inch carriage, equipped with an overhead bail is the equipment used on the system now being installed by some of the villages and smaller towns.

The overhead bail is used to hold the recapitulation sheet and carbon sheet in place while the bills are withdrawn and placed in position by front feed operation. With the use of tabulation it is possible to bill almost as quickly as with an automatic billing machine, as this typewriter method gives a typed bill and a recapitulation of the entire billing in a single operation by using a sheet of carbon paper. The results obtained are identical to those of mechanical machines with one exception, that the adding equipment is not available with the typewriter.

Control of the revenue billed is obtained in many of the smaller offices, but few of them at present are able to prove the billing. The systems of billing in use are many and varied. Most of the smaller offices are now billing on the ledger cards by hand and typing their bills without any proof of the calculations. A few municipalities who prove their charges actually do the work three times. The ledger card is written, the bill is typed and the recapitulation is either written or typed. It is possible to record the billing on the typewriter and in one operation make the bill, the recapitulation and the ledger record. This is accomplished by introducing the Ledger Stub Plan of billing.

This plan is in use in some municipalities where mechanical billing equipment is installed and a few of the smaller offices are using the plan with the aid of the typewriter. It has, however, been tried and found to be not only efficient and effective, but has saved time in practically every operation necessary in the work of billing, collecting, recording and balancing.

The accompanying diagrams give a fair idea of the operations required in using the typewriter for this work. Fig. 1 is the recapitulation shee obtained by the use of carbon paper. The bill is shown in Fig.2 after account number 1008 has been completed.

RECAPITULATION DOMESTIC BILLING JUNE 1ST 1934.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1001 | 290 | 180 | 110 | | 1.32 | 5.72 | 5.15 | 5.72 | 5.15 | | 5.72 | 5.15 | |
| 1002 | 3170 | 2970 | 120 | 80 | 1.32 | 7.72 | 6.95 | 7.72 | 6.95 | | 7.72 | 6.95 | .77 |
| 1003 | 2480 | 2390 | 90 | | 1.32 | 4.92 | 4.43 | 4.92 | 4.43 | | 4.92 | 4.43 | |
| 1004 | 4160 | 4050 | 110 | | 1.32 | 5.72 | 5.15 | 5.72 | 5.15 | | 5.72 | 5.15 | |
| 1005 | 6320 | 6110 | 120 | 90 | 1.32 | 7.92 | 7.13 | 7.92 | 7.13 | | 7.92 | 7.13 | |
| 1006 | 1410 | 1220 | 120 | 70 | .66 | 6.86 | 6.17 | 6.86 | 6.17 | | 6.86 | 6.17 | .69 |
| 1007 | 5370 | 5360 | 10 | Min. | | 2.22 | 2.00 | 2.22 | 2.00 | Min. | 2.22 | 2.00 | |
| 1008 | 6840 | 6220 | 120 | 500 | 1.32 | 16.12 | 14.51 | 16.12 | 14.51 | | 16.12 | 14.51 | |
| | | | | | ARR. | 10.60 | 10.60 | 10.60 | 10.60 | ARR. | 10.60 | 10.60 | ARR. |
| | | | | | TOT. | 26.72 | 25.11 | 26.72 | 25.11 | TOT. | 26.72 | 25.11 | TOT. |
| | | | 10 | | | | | | | | | | |
| | 30040 | 28500 | 790 | 740 | 8.58 | 57.20 | 51.49 | 57.20 | 51.49 | | 57.20 | 51.49 | |
| | | 790 | @ 4¢ | | 31.60 | 5.72 | | | | | | | |
| | | 740 | @ 2¢ | | 14.80 | 51.48 | | | | | | | |
| | | 10 | Min. | | 2.22 | | | | | | | | |
| | | 30040 | | | 57.20 | | | | | | | | |

*Fig. 1*

**REBUND HYDRO-ELECTRIC SYSTEM**

**LIGHTING SERVICE**

| PRESENT READING | PREVIOUS READING | CONSUMPTION @ 1ST RATE | CONSUMPTION @ 2ND RATE | SERVICE CHARGE | GROSS | NET | GROSS | NET | | GROSS | NET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6840 | 6220 | 120 | 500 | 1.32 | 16.12 | 14.51 | 16.12 | 14.51 | | 16.12 | 14.51 | |
| | | | | ARR. | 10.60 | 10.60 | 10.60 | 10.60 | ARR. | 10.60 | 10.60 | ARR. |
| | | | | TOT. | 26.72 | 25.11 | 26.72 | 25.11 | TOT. | 26.72 | 25.11 | TOT. |

JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC.

LIQUIDATION

| DATE | AMOUNT | BALANCE | DATE | AMOUNT | BALANCE |
|---|---|---|---|---|---|
| | | | | | |

MR. JOHN BROWN
25 HYDRO AVENUE, 13
REBUND, ONT

13

**Date of Bill**
1-6-34

**Last Discount Date**
15-6-34

MR. JOHN BROWN,
25 HYDRO AVENUE, 13 13
REBUND, ONT.

*Fig. 2*

The recapitulation sheet measures 12 in. wide and 14 in. long. The typing space on the bill from the present reading to the net amount on the ledger stub measures 10 in. leaving one inch on the left side of the recapitulation sheet for the account number, and one inch on the right side of the sheet for recording forfeited discounts. The carbon sheet is 10 in. wide as only the billing is copied to the recapitulation sheet. The account number on the recapitulation sheet acts as a guide when placing the bill in the typewriter and at the same time identifies each billing on the recapitulation sheet.

The billing operations are as follows:—The recapitulation sheet with the carbon sheet and bill placed one inch from the left side of the recapitulation sheet is placed in the typewriter, using the guide on the frame at the back of the machine. The account number is typed on the recapitulation sheet only, using the one inch margin on the left side. The billing figures are then typed using the tabulation on the machine for spacing purposes. When the carriage is returned the platen is spaced vertically at the same operation, the next bill is inserted between the bill and the carbon paper in the typewriter and the completed bill withdrawn.

Minimum bills are marked as such and in proving the recapitulation they are treated as they are with the automatic machine. The arrears can be typed and marked "Arrears", but until the operator becomes used to the operation of typewriter billing with the overhead bail, I would suggest that the arrears be added by hand.

The completed recapitulation sheets are added on the adding machine and proved as shown on the form.

The time saved in using this system could be profitably used in controlling the revenue, and in offices where the revenue is at present under control, the time could be used in keeping a running summary of all recapitulation sheets, so that at the end of the year the peak work of compiling statistics can be eliminated.

*Ear Falls Development, Lac Seul.*

# Strain Insulators

## Why Used and Where Inserted

It is a well known fact that a wood pole, even when wet, is a fairly good electrical insulator. This fact is made use of in the design of wood pole power lines in that the insulators used have lower insulating properties than those used on steel lines of the same voltage.

To provide against unbalanced strain in the line, it is necessary to attach metal guys to the poles occasionally. These guys, if not insulated, have the effect of bringing the ground up the pole to the point of attachment of the guy thus losing the insulating properties of the pole between this point and ground.

The uninsulated guy becomes a triple hazard, firstly a lineman working on a pole may make contact with a live wire and the guy, secondly the metal guy wire at the ground may be touched by any person and, in case of contact between guy cable and live equipment, may carry a dangerous voltage to ground, and thirdly when

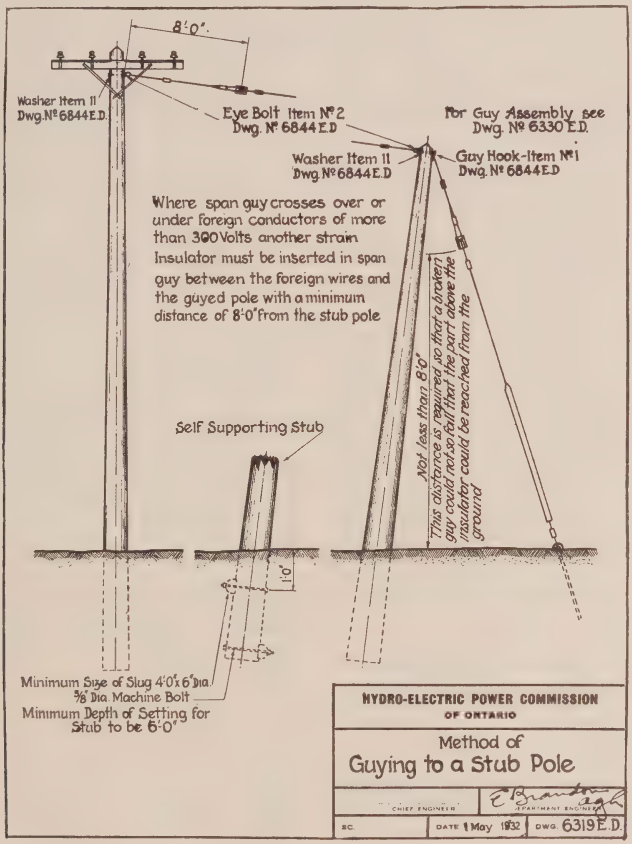



*Fig. 1*

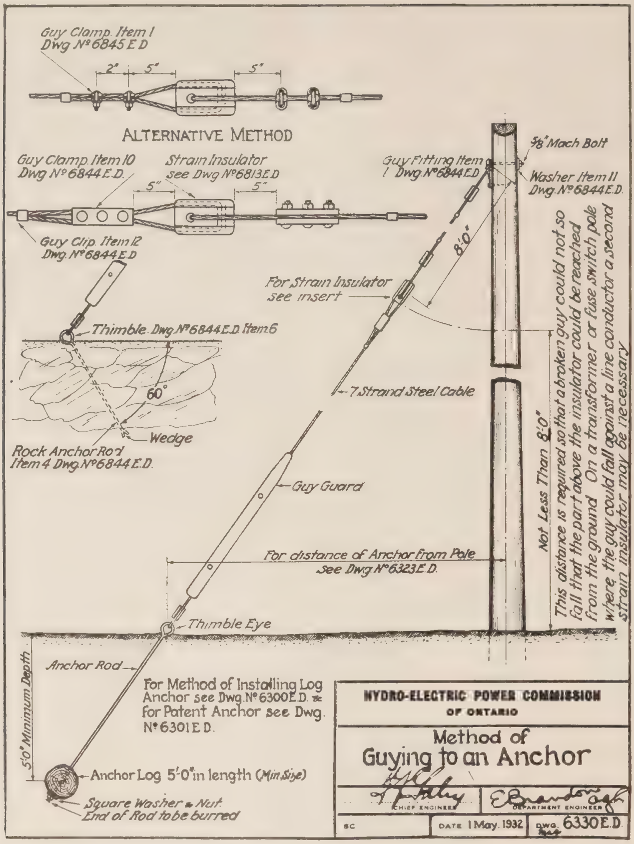



*Fig. 2*

the guy passes under or over another high voltage line there is the danger of contact with the conductors of the other line thus causing a hazardous voltage on the guy cable.

The above hazards may be eliminated by the use of strain insulators in the guy cable as follows:—

### (a) To Protect Linemen on the Pole

1. *Guy to Anchor*

Insert a strain insulator in the guy cable at a distance of at least eight feet from the pole measured along the guy cable.

2. *Span guys to another pole*

Insert a strain insulator in the span guy at least 8 feet away from the guyed pole or stub.

### (b) To Protect the Public

The strain insulator inserted as in (a) will be sufficient provided that, in case of a guy cable breaking and the guy swinging against the pole, the strain insulator will be below any live equipment on the pole and not less than eight feet above the ground; otherwise a second strain insulator should be inserted near the lower end of the guy so that, in case of the guy breaking and swinging against the

pole, the strain insulator shall not be less than eight feet above the ground.

(c) TO PROTECT FROM FOREIGN LINES

In span guys which cross over or under the wires of a pole line carrying more than 300 volts to ground, two strain insulators should be installed so that the section under or over the other line shall be insulated from both poles.

POLES CARRYING SECONDARY ONLY

On lines carrying conductors of less than 300 volts to ground there is scarcely sufficient hazard to make the use of strain insulators in guy cables necessary. However, since in a great many cases circuits of higher voltage are added, it would appear that the insertion of the strain insulators at the time of installing the poles would be advisable in all cases.

## How a Horsepower Got That Way

There had been little need for a practical unit of power until James Watt began to sell steam engines. Watt was quite an engineer. He could figure out the rate at which his engines could do work, that is, their power, but it didn't seem to help him much, for the customer never knew what power he needed. Almost all the engines Watt sold were for mine pumping. Previous to Watt's time almost all mine pumps had been driven by horses walking round and round in a circle like an old-fashioned horse-driven threshing rig. The prospective customer generally knew how many horses had been required to keep his mine pumped out. Watt decided that if he could only determine the rate at which a horse could work steadily all day long, he would have something to go on in estimating the size of engine required by a prospective customer who knew how many horses he was using.

To avoid any argument as to the difference in power of horses, Watt experimented with big powerful draft horses which pulled drays and trucks in London. Watt, or his partner, Boulton, borrowed such horses from the brewer who supplied their table. He may also have been a friend and neighbour for all I know.

During these tests, the horses lifted stone weights from a well or a pit. Watt and Boulton concluded that a powerful horse could do work at the rate of 33,000 foot pounds per minute and keep it up for an eight-hour day.

This particular value for "the power of a horse" was questioned by many of the early mechanical engineers of distinction. It raised almost as much controversy during the next thirty years as did, in later times, the exact value of the mechanical equivalent of heat or the atomic weight of oxygen as related to that of hydrogen. Several men, famous mechanical engineers of their time, made independent determinations of a "horse's power".

As compared with Watt's and Boulton's value of 33,000 foot pounds per minute for the power of a horse working an eight-hour shift, D'Aubuisson, experimenting with horses operating capstans at Freiberg, obtained 16,440 for an eight-hour shift; Desaquiler obtained 44,000, perhaps for a shorter working shift; Smeaton in England

obtained 22,000; and Thos. Tredgold, 27,500.

In spite of such controversies, Watt's and Boulton's original value has been the accepted unit of power in English-speaking countries for more than a century.

D. W. Roberts.
In the *Electric Journal.*

# Electrical Phenomena at Very Low Temperatures

THE twenty-fifth Kelvin Lecture was delivered by Professor J. C. McLennan, D.Sc., LL.D., F.R.S., at a meeting of the Institution of Electrical Engineers on Thursday, April 26, the subject being "Electrical Phenomena at Very Low Temperatures." Prior to the lecture, the Faraday Medal for 1934 was presented to Sir Frank Smith, K.C.B., C.B.E., D.Sc., F.R.S., by the President (Mr. P. V. Hunter).

The history of the subject, with which he had to deal, said the lecturer, went back just over 100 years. It was in 1823 that Faraday succeeded in liquefying chlorine by heating some hydrate of chlorine in one leg of a U Tube and liquefying the vapour under its own pressure in the other leg. He subsequently succeeded in liquefying many other gases, though he failed with oxygen, nitrogen and hydrogen, owing to an inability to attain a sufficiently low temperature above which liquid could not exist, whatever the pressure. This critical temperature was 31.7 deg. C. for carbon dioxide, but was as low as −118 deg. C. for oxygen and −146 deg. C. for nitrogen. To attain these temperatures, the gas was either made to do work on a piston or was cooled by expanding it through a nozzle, the gas thus cooled being led back over the coil supplying the jet. If, however, the gas was not first cooled below the critical temperature it became hotter, and not cooler, when it was expanded through a fine nozzle. At the end of the war, a large stock of helium was available in Toronto, and this gas was successfully liquefied in 1923, just a century after Faraday's experiment with chlorine, by cooling it below −268 deg. C. with rapidly evaporating liquid hydrogen, and thus attaining a temperature of 4.2 deg. absolute. By evaporating liquid helium, and thus reaching an absolute temperature of 0.7 deg., Keesom of Leyden had succeeded in solidifying this element, in February, 1932. He exposed the liquid to a pressure of 175 atmospheres and simultaneously surrounded it by rapidly evaporating liquid helium.

These low temperatures were measured by using hydrogen or helium in a constant-volume thermometer or, when the pressure of the gas became very small, on a Macleod gauge or a hot-wire anemometer. For temperatures below that at which helium liquefied, the temperature could be deduced from the vapour pressure which was accurately measurable over the range between 4.2 deg. and 1.4 deg. absolute. Below 1.4 deg. abso-

lute they were determined by extrapolation and temperatures down to 0.7 deg. absolute, the freezing point of helium, could then be measured with the greatest ease to within 1/1,000 deg.

As regards electrical phenomena at these very low temperatures, if a highly paramagnetic salt was cooled down to the temperature of liquid helium in a magnetic field and the field was reduced from 30,000 gauss to 1,000 gauss, there was an immediate lowering of the temperature, which could be measured by noticing the change which the alteration in its susceptibility produced in the pull on the arm of the balance from which the tube containing the salt was suspended. This arrangement offered great possibilities as a means of obtaining very low temperatures. It had also been found that liquid oxygen, hydrogen and helium were very good insulators, the reason probably being that the electrons were closely bound to the nuclei, while in a conductor the attachment could be more easily disturbed. In 1893, Dewar and Fleming, experimenting on the resistance of metals at low temperatures, had obtained results which seemed to indicate that the resistance of all pure metals would vanish at 0 deg. C. absolute. In 1911, however, Kamerlingh Onnes had found that this was not true as the resistance of mercury vanished suddenly when its temperature was reduced to 4.2 deg. C. absolute and that other metals showed the same phenomena at characteristic temperatures. Most metals, however, exhibited no trace of this superconductivity even when special care was taken to ensure their purity, but certain alloys and chemical compounds became super-conductive at low temperatures, even when their individual constituents did not. The super-conductivity of a metal or alloy could be destroyed by placing it in a magnetic field, and the lower the temperature the greater the magnetising force necessary to restore that condition. On the other hand, by suddenly destroying the magnetic field surrounding it, a current could be set up in a ring of super-conductive metal, if its temperature were below the transition point. The strength of this current was quite independent of the nature of the metal and depended solely on the intensity of the original induction. It was also found that the specific heat dropped as the temperature was lowered, until the transition point was reached, when it increased, while the rule that a good conductor of electricity was also a good conductor of heat no longer applied at the lowest temperatures.

During the last few months two other great discoveries had been made. Two rods of tin had been placed perpendicularly to a magnetic field and cooled down gradually. Just as the transition point was passed it was noted that the field spread out on both sides of the rods, and also became concentrated in the space between them. In other words, the magnetic permeability of the metal had decreased to zero. It would be interesting to know what had occurred to account for this change. If a current was passed up one rod and down another, with no external magnetic field, and the system was gradully cooled down, it was found that the field induced by the current crowded into the space

between the two rods, while if tubes were used instead of rods, the lines of force were distorted on either side of each tube and a field was also set up in the interior air space. This field, which apparently was not closed, persisted when the field was cut off, a condition which had hitherto been regarded as impossible. These results, which had been checked by exploring the conditions surrounding a cylinder of tin 3 cm. in diameter with a number of search coils, must give rise to new ideas on the subject of electrical conductivity. Lead conductors carrying currents of a frequency of $10^{14}$ per second were not super-conductive at low temperatures, but were super-conductive when a direct-current was passed through them. Metals such as tin and lead were, however, super-conductive when subjected to radio waves of a frequency of $10^3$ per second. With films of tin about $10^{-3}$ c.m to $10^{-4}$ cm. thick, the transition temperatures were the same with alternating currents of frequencies up to $10^7$ as with direct-current, but films of tin less than $2 \times 10^{-5}$ cm. thick did not exhibit superconductivity at temperatures as low even as 2 deg. C. absolute. Professor E. F. Burton and his co-workers at Toronto had recently discovered that films of tin, plated on both sides with copper or nickel, were not super-conductive at the lowest temperatures unless the thickness exceeded 30 x $10^{-5}$ cm. The transition temperatures of wires or films of super-conductive metals fell gradually as the currents were increased.—*Engineering.*

*Hanna Chute Development, Georgian Bay System.*

## On the Threshold of a New Electrical Era

Electric power is accepted by industry as the best power. Electric light stands supreme in comfort, convenience and adequacy. Electrical communication has made one great family of the world. These things are recorded to the glory of electrical engineers.

What remains to be done? The answer of the electrical engineers is that there is far more to be accomplished than has been done—or even dreamed of. But, unfortunately, the answer of too many non-technical electrical industry men shows less imagination or courage. The engineer group is familiar with the imperfection of present accomplishments, with the knowledge of recently developed new products and new technology, with reasonable expectations from the research workers. The non-technical group too frequently has been concentrating only upon the business vexations that came with the depression. But the engineers have the truer knowledge and the better perspective.

At this time the electrical industry should follow the advice of Marcus Aurelius and "go forward by the straight path, pursuing your own and the common interest." In industry, electricity is represented largely by the motor only. Electric heat, electrochemical processing, air conditioning, electric control and numerous embryonic industries that will become full-fledged in the near future offer great possibilities. One talks about 600 kw-hr. per home per year, when the actual accomplishment of 4,500 kw-hr. per year is to be found in several instances. One looking at the new equipment developed in recent years should appreciate the enormous amount of technological obsolescence that is certain to create a huge replacement market. There are, at least figuratively, anti-complacency bombs nearing completion in research laboratories. In manufacture, in transportation, in the home, on the streets—electricity and electrical products promise contributions far larger than those made in the past.

Electric power in the future will be so cheap that its use will be abundant. Electrical products and services will be so numerous that their aggregate volume will stagger the imagination. Present markets are unsold, new markets will be opened, present costs will be reduced enormously. This great boon for mankind will not be stopped by artificial barriers such as legislation, taxes, lack of money or a host of real and imaginary handicaps. This is the future of the electrical industry. It is not a prophecy, but a reasonable assumption based upon knowledge and rational perspective. Electrical industry men will work enthusiastically to bring this future to hand. The work is here to be done, the incentives exist and the handicaps are minor. Stimulated by their environment and firm with faith in the future, electrical men are going forward.—*Electrical World.*

# Association of Municipal Electrical Utilities

## Minutes of Executive Committee Meeting

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the office of the Hydro-Electric Power Commission of Ontario, on Wednesday, September 5th, 1934. Those present were—Messrs. W. R. Catton, *Chairman*, T. J. Hannigan, O. M. Perry, O. H. Scott, E. V. Buchanan, T. W. Brackinreid, P. B. Yates, D. B. McColl, M. W. Rogers, J. R. McLinden and S. R. A. Clement.

Mr. T. Stewart Lyon, Chairman, Hydro-Electric Power Commission, attended and welcomed the committee members. He expressed the wish that the Association submit ideas towards increasing the sale of power.

It was moved by Mr. O. H. Scott and seconded by Mr. O. M. Perry, "THAT the Minutes of the Executive Committee meeting of April 3rd, and of the Convention at Ottawa on June 28, 29 and 30, 1934, be taken as read and approved."—*Carried.*

A letter from the Royal Connaught Hotel, Hamilton, asking to be considered for a meeting place for the Winter convention, was read.

Another letter from the Royal York Hotel, Toronto, submitting a proposal for the Winter convention, was also read.

It was moved by Mr. O. M. Perry and seconded by Mr. T. W. Brackinreid, "THAT the Winter convention of the Association be held at the Royal York Hotel on January 30 and 31, 1935, if the dates of January 29th and 30th cannot be obtained."—*Carried.*

A letter from the Secretary to the President dated August 13th, 1934, was read. There was no action taken on this.

Mr. D. B. McColl, Chairman, Papers Committee, reported progress towards obtaining papers for the convention.

It was moved by Mr. M. W. Rogers and seconded by Mr. P. B. Yates, "THAT there be a meeting of the Executive members at Brantford on Tuesday, September 18th, to draft suggestions as suggested by Mr. Lyon."—*Carried.*

It was moved by Mr. O. H. Scott and seconded by Mr. O. M. Perry, "THAT there be a convention dinner and two convention luncheons: 'THAT the Electric Club of Toronto be invited to one of the convention luncheons and be asked to supply the speaker;' and 'THAT Mr. Lyon, Chairman, Hydro-Electric Power Commission of Ontario, be asked to speak at the convention dinner'."—*Carried.*

Mr. P. B. Yates, Chairman, Rates Committee, reported that that committee had prepared suggested revisions to the Standard Interpretations of Rates, and that they are now waiting for a meeting with the Rate Committee of the Hydro-Electric Power Commission to discuss these.

Mr. D. B. McColl submitted a letter he had received from Mr. F. A. Murphy, Sangamo Company Limited,

suggesting that this Association consider the formation of a Metermen's Association. It was moved by Mr. T. W. Brackinreid and seconded by Mr. E. V. Buchanan, "THAT Mr. Murphy's proposal regarding the formation of a Metermen's Association be referred to the 1935 Executive." —*Carried.*

The meeting then adjourned.

## The Science of Seeing

Lighting and vision are merely tools for seeing. A science of vision has been developing for a long time. This deals with the limitations and abilities of the eyes as tools. Similarly, the production and control of light deal with another tool. But seeing is more than these tools. It is an activity of human beings operating as human seeing-machines. This conception is responsible for the recent rapid development of the new science of seeing. Now we know that seeing consumes human energy and other resources just as any other task does. Now we are no longer satisfied to barely see. To see easily is the new goal. Lighting now becomes a science with the forging of the third link—specification of lighting for human seeing-machines. The other two links —production and control of light—have been well developed for a long time. A chain is as weak as the weakest link. As long as the science of seeing was not available, the third link—specification—was very weak. Such an analysis of lighting readily explains the general lack of lighting consciousness, the low intensities which satisfied everyone, the lack of confidence and power in lighting offensives, the vagueness of objectives, the inadequate enthusiasm for lighting, the looseness of thinking, the lack of co-ordinated offensive and even the absence of a lighting profession. The science of seeing is already changing all this. It is gathering forces for the greatest era in lighting development which can ever come into the lighting business. A science provides knowledge which in turn gives us the courage to do things. Lighting development has needed both of these.

Human seeing-machines are interested in three factors: the visual task, the eyes and lighting. Improvements in seeing depend upon control over one or more of these factors. Visual tasks may sometimes be improved by someone, but generally they must be accepted as they are. Eyes can be fitted with glasses, if necessary, but their ability is fixed. However, lighting is universally controllable. This promotes it from insignificance to a major role in seeing. This explains why the approach to lighting through seeing awakens a lighting consciousness more than all the combined efforts of the past.

—*Magazine of Light.*

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


# Transformer Stations in Abitibi District

## Supply Hydro Power to Northern Ontario Mines

**By G. E. Kewin, Assistant Engineer, Electrical Engineering Department, H.E.P.C. of Ont.**

THE Hydro-Electric Power Commission of Ontario has constructed in the Northern Ontario mining district during the year 1934 two transformer stations, one at Kirkland Lake and the other at Matachewan for delivery of power from the generating station at Abitibi Canyon. A single circuit, 132 kv., wood pole line 58 miles in length, was constructed from Iroquois Falls to Kirkland Lake for supply to this latter point. This line is an extension to a previously constructed steel tower circuit, 95 miles long, from the generating station to Iroquois Falls. A further extension of wood pole construction was made from Kirkland Lake to Matachewan, a distance of 40 miles, for supply to the latter place.

### Kirkland Lake Transformer Station

The Kirkland Lake station is located in the Township of Teck in which township are located well-known gold mining properties such as Lake Shore, Teck Hughes, Sylvanite and Wright-Hargreaves mines. It was constructed to supply power under contract with the Canada Northern Power Corporation Limited at their station located at Kirkland Lake and to other mining customers in this district.

The Commission's station is located immediately adjoining this customer's station on property covered with gold mine tailings under which was muskeg. Although it was known before selecting this site that ground conditions over most of the site were not desirable for foundations, it was chosen as being most suitable, due to its closeness to the Canada Northern Power Corporation's station and due to surrounding conditions readily permitting the bringing in of the 132 kv. line to the site and the taking away of outgoing overhead feeders from the station.

## CONTENTS

**Vol. XXI** **No. 10**

**OCTOBER, 1934**



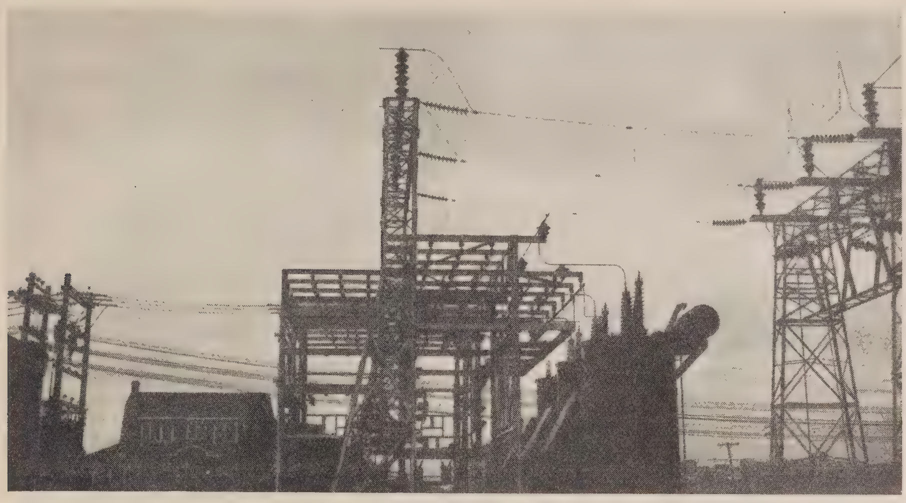
The station is of the outdoor type construction except for the pump house, which houses the water pumps and oil filter. As the property was subject to be flooded with mill tailings, precautions against this were taken by raising the property level 3½ feet with crushed rock, which was readily obtained in the immediate vicinity from the waste rock piles of the mines.

The bus and switch structures are of galvanized fabricated steel. The pump house and cooling pond are concrete. The transformers, the low voltage bus and feeder structure, the pump house and the cooling pond are located on concrete foundations constructed on bed rock which, on this portion of the site, was only a few feet below the surface. Wood piles were driven, on top of which concrete pads were poured for the balance of the structure foundations. All piles were driven to refusal, the maximum depth being 49 feet.

The basis of the electrical design of this station is that all future loads in the immediate vicinity will be supplied at 13,200 volts and that, in order to meet the requirements of the contract with the Canada Northern Power Corporation, power would be supplied to them from the 13,200 volt bus through a voltage regulating transformer to match this customer's bus voltage.

In order to meet these requirements, three separate busses are provided, namely, the 132,000 volt bus which is the nominal voltage at which the power is received from the Canyon Generating Station, the 13,200 volt feeder bus for future local feeders and the voltage regulated bus, nominally 12,000 volts, for supply of

*General view of 132 kv. structure, Kirkland Lake transformer station.*



*Kirkland Lake low voltage switching and transformer station looking south.*

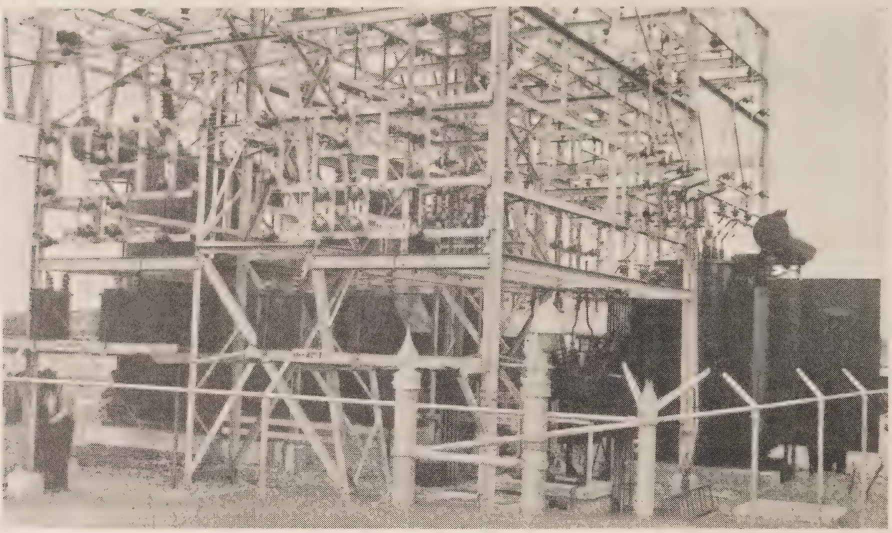
power to the Canada Northern Power Corporation. The Bidgood-Kirkland Gold Mines Ltd. is also supplied from this latter bus.

The station wiring diagram indicates in full lines the equipment now installed and in dotted lines the equipment for which provision has been made for future installation.

The electrically-operated, 132,000 volt disconnecting switches are special in order to break approximately 10 amperes at 132,000 volts when required to break the charging current of 40 miles of line to Matachewan or the magnetizing current of the bank of three 9,500 kv-a. transformers. These switches have a phase spacing of 16.5 feet and are of the centre break type with each insulator stack rotating 180°, the insulators being spaced at 10 feet. The point of contact of the arcing horns is 12 feet above the top of the insulator stacks. When the switch is open, the tips of the arcing contacts are 20 feet apart. A portion of the arcing horns are insulated on the outside to prevent the arc travelling down the horns Provision has been made so that if future requirements demand oil circuit breakers on the Matachewan line and on the transformer bank, they may readily be installed under the structures on which the disconnecting switches are mounted.

Three 9,500 kv-a., 25 cycle, single phase, water-cooled transformers connected star on the high voltage side and delta on the low voltage side form the transformer bank. They have a voltage rating of 117,600 volts to 12,000 volts but are capable of

*132 kv. air break switches, Kirkland Lake transformer station.*



*Low voltage and transformer structure, Kirkland Lake transformer station, looking north-west.*

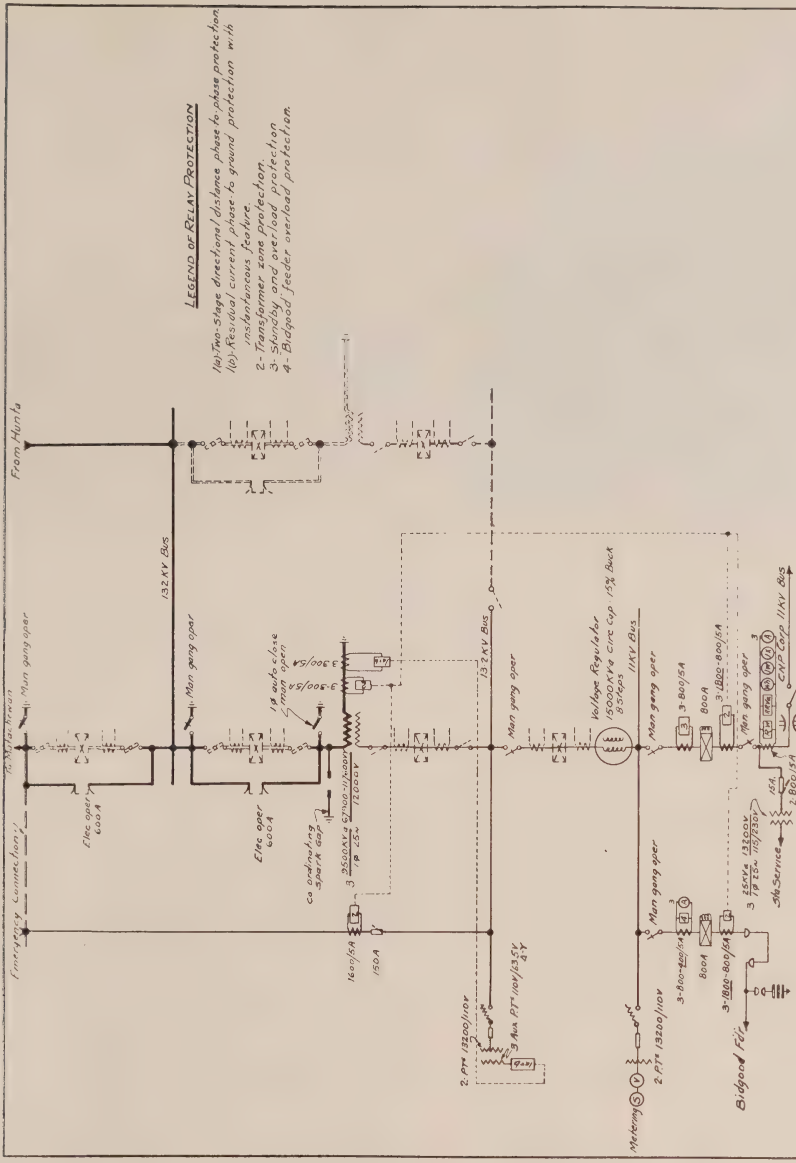
being operated at 132,000 volts to give a transformed voltage of 13,200 volts. Gaps 39¼ inches to ground co-ordinated with the transformer insulation are on the 132,000 volt bus to protect the transformer winding against voltage surges.

The 15,000 kv-a. (circuit capacity), 13.2 kv. voltage regulating transformer is 3 phase, self-cooled and is capable of bucking the voltage 15 per cent. in eight steps. It has underload tap changing equipment which is motor operated by remote control.

The metering, relays and control of all remote-controlled equipment are located in the Canada Northern Power Corporation's station building.

The station is protected by high speed relay systems. In case of a 132 kv. line or station fault, the 12 kv. feeder breaker to the Canada Northern Power Corporation opens to cut off power infeed from their system and the line breaker at the Canyon Generating Station opens, clearing the power source from the latter station.

For transformer or station low voltage faults, a differential relay system causes the Canada Northern Power Corporation's feeder breaker to open and an automatic single phase ground switch, located between the transformer air break switch and the transformer, to close creating a ground on the 132 kv. system causing the Canyon line breaker to open. The closing of this ground switch automatically opens the transformer air break-switch isolating the fault from the 132 kv. transmission system so that the line may be immediately energized to supply other loads. In order to prevent this differential relay operating due to initial rush of magnetizing current when energizing the transformer bank, the relay is desensitized for a short period. The low voltage feeders are protected by inverse time overload relays




Wiring diagram, Kirkland Lake transformer station.

with instantaneous attachments for heavy faults.

Water for the transformers is cooled in a cooling pond equipped with sprays. Two motor-driven pumps, each rated at 100 gallons per minute, are provided for circulating the water, one pump being capable of handling the present requirements. Make-up water is obtained through a connection to the Township of Teck water mains.

Oil storage space consists of one 4,300 gallon tank sufficient to store

*Moving transformers to Matachewan transformer station.*

the oil contained in one 9,500 kv-a. transformer. Underground piping between filter, oil tank and transformers permit ready filtering and pumping of oil.

As a portion of the 2,300 feet of roadway over which the transformers had to be moved from the railway cars to the station site was constructed over muskeg, it was necessary to reduce the weight of the transformers and the weight per unit area of roadway to a minimum in order not to break through the road or cause the road to depress. This was accomplished by reducing the weight of each transformer from 61 tons to 42 tons by shipping the transformers filled with nitrogen instead of oil and planking the roadway and moving the transformers on rollers.

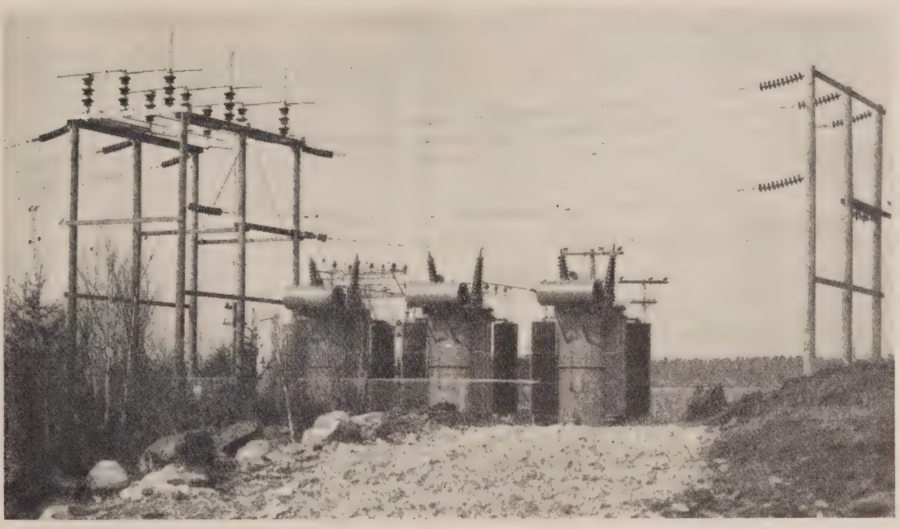
Initial delivery of power by the Commission to the Canada Northern Power Corporation at Kirkland Lake was made on February, 1934, by a temporary connection from the transmission line to their high voltage bus. The construction of the permanent station was started in February, 1934, and the station was put into operation in July.

### Matachewan Transformer Station

The Matachewan Transformer Station is located in the Township of Powell and was built primarily for the supply of 26.4 kv. power to the Hollinger Consolidated Gold Mines Ltd. for operating mining properties in this vicinity. The construction is of the outdoor type. Wood poles are used for the high voltage structure and galvanized pipe for the 26.4 kv. structure. A small sheet metal building houses the meters, relays and tripping battery.

The equipment consists of an automatic opening air break disconnecting switch on the incoming 132 kv. line, an automatic closing 132

*Moving transformers to Matachewan transformer station.*



*Matachewan transformer station.*

kv. grounding switch, three 1,500 kv-a., 25 cycle, single phase, self-cooled, 121,000 to 27,720 volt transformers and an automatic 26.4 kv. feeder oil circuit breaker. Two customers are supplied through this feeder breaker, namely, the Young-Davidson Mines Ltd. and the Matachewan Consolidated Gold Mines Ltd.

The 26.4 kv. feeder is equipped with overload current protection with instantaneous feature. Timed overload protection connected to the current transformers on the high voltage transformer bushings protects the station equipment. In case of a station fault, the automatic single pole grounding switch closes and the line air break switch opens in a similar manner to that described for the Kirkland Lake Station. The transformer is protected against abnormal voltage surges by spark gaps co-ordinated with the transformer insulation. These are located close to the transformer terminals on both the high voltage and low voltage sides.

Each transformer was set on skids 16 feet long with steel runners and were hauled by means of tractors over 26 miles of snow-covered roadway from the nearest railway point at Elk Lake to the station site. It was necessary to transport these under winter conditions as it was required that the station be ready for operation on May 1st, and road conditions would have made it impossible to transport them in the Spring. As there were 15 bridges of strength for only moderate loads, the weight of each transformer was reduced from 26 tons to 15 tons by replacing the oil with nitrogen.

Construction of the station was started the latter part of March and was completed and put into service on April 29th.

* * * *

The Smooth Rock Falls (Steam) Transformer Station was also constructed during the year 1934 in the Abitibi District. A description of this will be dealt with in a separate article.

## W. D. Annis, Scarborough Township

William David Annis, Secretary-Treasurer of Scarborough Public Utilities Commission, died at his home at Scarborough Village, in Scarborough Township, on Thursday, July 26th, 1934. He was born in the year 1867, the son of Jeremiah Annis and Jane Fawcett, both pioneer settlers of that township. As a boy he attended the village public school and later Jarvis Street Collegiate, Toronto.

While yet a young man, Mr. Annis became interested in local municipal affairs and in the year 1902 was elected Councillor. He was re-elected Councillor in 1903, 1904, 1905, 1906 and 1907. In 1908 he became Reeve of Scarborough Township, and was returned for the years 1909, 1910, 1911 and 1912. He was appointed Clerk of the Township in 1913, in which capacity he served for 18 years.

In addition to being Clerk of Scarborough Township, Mr. Annis became Secretary-Treasurer of the York County Children's Aid Society, Secretary-Treasurer of Scarborough Collegiate Institute, and Secretary-Treasurer of the Scarborough Public Utilities Commission. He resigned from the Clerkship of the Township in 1931, due to failing health, but held the other three offices until his death.

*William David Annis*

Mr. Annis is survived by his widow and daughter. He had many admirable qualities; he was always kind and considerate towards all those associated with him. The members of the Public Utilities staff loved him and held him in high esteem, as did all others who were associated with him in his public and private life.

*Cameron Falls development on the Nipigon River*

# International Plowing Match and Machinery Demonstration

THE International Plowing Match and machinery manufacturers' demonstration was held this year on the Maryvale Farms, north of Wexford, in York County, Mr. Frank O'Connor, the genial owner, acting as host to many and general supervisor of all activities. Mr. J. Lockie Wilson, the veteran Managing Director and Secretary, as usual with his affable good nature kept everything moving smoothly. Much credit is due to the directors of this association, who each year have a plowing match which is the greatest of any in the world in number of contestants and interested observers.

The Hydro-Electric Power Commission of Ontario, with the co-operation of electrical and power-using equipment manufacturers, this year made a somewhat larger demonstration, improved in set up to be in accord with surroundings on this and the adjacent nicely appointed farms.

The demonstration was housed in a tent 70 ft. by 40 ft., with a centre partition to provide separation of the household from the barn and dairy equipment. A small annex tent contained a complete sanitary and water system to emphasize the simplicity in set up and cost of a system suitable for farm or rural residents.

The exhibit featured especially the

*The tented city and one parking area at Maryvale Farm, Wexford, during the Plowing Match. The haze at the time prevented the panorama from showing clearly the area in which the contests were being held.*

free water system and free power for sanitary water systems, washing machines and radios, as the Commission wishes all rural residents to be familiar with these advantages. Engineers were in attendance to supply full information on these features as well as on the use and application of the equipment shown.

The Commission wishes to thank manufacturers and others for their co-operation with them in this exhibit.

*Another view of the demonstration area at the Plowing Match. The Hydro demonstration was housed in the tent immediately to the right of the street entering the squared area.*

*View of Hydro demonstration tent looking towards squared concession area.*

*Main street in front of Hydro demonstration and headquarters tents.*


*Water systems in a variety to meet all requirements.*


*View showing electric hoover, grain grinder, milking machines, cream separators and electric moth and fly traps.*

*Refrigerators, ranges and washing machines in almost complete variety, were on display.*


*General view of interior from entrance to household section.*

*Opposite Page:*

*Top—Free water heater, small water heater, ironer and electric ranges.*

*Middle—Milk coolers for farms are now a necessity to the progressive dairyman.*

*Bottom—General view of barn and dairy section with utensils on the counter.*


FREE
Thor
Ironer


Milk

*General view from rear of tent towards entrance, shows the completeness of the lines of equipment. Milk coolers, grain grinders, milking machines, cream separators, soil heaters, moth and insect traps and screens, electric motors and motor parts made a display which attracted much interest.*

*Complete sanitary set-up with water service system.*

# Electric Soil Heating

**By J. W. Tomlinson, Winnipeg Electric Company, Winnipeg, Man.**

*(From a Paper presented before the Winnipeg Branch of The Engineering Institute of Canada, March 1st, 1934, and published in the "Engineering Journal".)*

IT is of interest to know that the feasibility of supplying heat directly to the soil by electricity was first realized by a Norwegian engineer, more or less by accident. While examining a network of overloaded underground cables he noticed that the vegetation over them was greener and more advanced than elsewhere. From this he conceived that the deliberate conversion of electricity into heat by means of a buried resistance would result in an efficient and easily controllable means of promoting plant growth. During 1922 his experiments were successful, in fact so successful that inside of five years over 12 per cent. of all the hotbed sash in Norway was electrically heated. This development was almost paralleled in Sweden, where we find 5,900 square yards of electric hotbeds by 1927 and 24,000 square yards in use by 1929. Denmark, Holland, France, Germany and England have adopted the idea more or less in inverse proportion to the cost of electric power in the different countries. About 1926 saw the introduction of electric soil heating in the United States. By 1929 the power companies became interested in its possibilities with the result that by 1932 over one million kilowatt hours were known to have been used in this way, and in spite of low price levels and other disturbing features the consumption for 1933 is already four times that for 1932. The records show that 2,000 thermostats and 330,000 feet of cable were sold between May, 1932, and May, 1933. This increasing use everywhere must mean that the heating of soil electrically is economical as well as more efficient.

It was not long before the Canadian power companies undertook to introduce electric soil heating to the Canadian grower. In doing this they have a fortunate advantage in the fact that power rates are on the average much lower than in other countries where electric soil heating has already proved a commercial success.

In 1932 numerous installations were put in in the market gardening districts around Montreal where the Shawinigan Power Company has been the chief sponsor. In Ontario the Hydro-Electric Power Commission has taken an active interest in several installations. In Manitoba the Winnipeg Electric Company is sponsoring experimental installations, and in British Columbia the B.C. Electric Company has already proved its practical value.

### ADVANTAGES

The fact that the power companies have been behind most of the experimental installations would indicate that electric soil heating must constitute a desirable load. It is true that the transforming of kilowatt-hours into vegetables and flowers can be made profitable both to the pro-

ducer of kilowatt-hours and to the producer of vegetables and flowers. From the power companies' standpoint:—

(a) The electric hotbed or propagating bench consumes annually an average of 1,000 kilowatt-hours per kilowatt of connected load, which compares favourably with most other electric appliances.

(b) The greatest consumption is during the early spring months when water power is most plentiful.

(c) Experiments show that it is at least 70 per cent. night load and therefore to a large extent an off peak load.

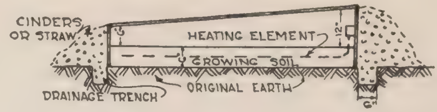
(d) For the most part it is connected to underloaded rural distribution feeders, helping them to stand on their own feet with little or no new capital expenditure for extra line equipment.

From the grower's standpoint there are many proved advantages, such as:—

(a) The soil temperature best suited to any particular crop can be maintained by thermostatic control, thereby improving growing conditions as well as insuring against sudden change or extreme weather conditions.

(b) Crops may be advanced or retarded at will. Often bringing a crop on the market on a certain fixed date, such as flowers at Easter, or Christmas means a great deal to the grower. With other crops, being able to place them on the market ahead of their competitors means much higher prices.

(c) The electric hotbed can be used in the fall of the year as well as the spring, since constant temperatures can be maintained as the weather grows colder, whereas this is impos-




*Cross section of typical electric hot bed**

sible with manure heat since it loses its heat when most needed.

(d) Several successive crops can be raised in the hotbed in one season without removing the soil. With manure heat the bed has to be emptied every six weeks or so and left a considerable time to allow the new manure to start heating.

(e) The electric hotbed is clean and free from ammonia fumes. This eliminates many forms of insect life and plant rot.

(f) A uniform temperature is maintained throughout the entire bed, a big improvement over the concentrated heat of a manure hotbed.

(g) The hotbed temperature can be readily lowered as desired and finally made into a virtual cold frame by merely adjusting the thermostat, yet the heat is always available and will automatically look after unexpected cold weather.

### General Layout

In its experimental stages the use of electricity to heat propagating benches and hotbeds was accompanied by a vast amount of detail regarding special construction features, mostly aiming to eliminate heat losses and thereby conserve electric power. For example, early experimenters claimed that in dull wet seasons as much as 22 per cent. could be saved in kilowatt-hours by totally insulating

* The bed banking should be maintained in a dry condition.—*Bulletin Editor.*

the hotbed from the ground by means of air spaces or cinders. This of course involved digging a pit to allow 6 to 8 inches of cinders under the entire bed and a one-foot embankment on all sides. While this no doubt prevented considerable heat losses it made construction more difficult and expensive and tended to make the job too complicated to appeal to the average grower. Also this bottom insulation was found to have a detrimental effect on the growth in the bed; this was especially noticeable in longer season crops such as cucumbers, celery, etc. However, 22 per cent. power saving could not be overlooked and therefore total insulation was recommended by early authorities.

More recent development indicates that these heat losses can be eliminated by changing the location of the cables instead of bottom insulation. Numerous other examples could be cited showing where construction has been simplified without sacrificing efficiency. However, consideration as to layout is still very important for hotbeds, such as southern exposure to get the maximum benefit of the sun, shelter from prevailing winds and good natural under-drainage. Having chosen a site with these things in mind the usual construction that applies to manure hotbeds has proved quite satisfactory.

### Heating Elements—Types Available

The most important feature of electric soil heating is, of course, the heating elements. There are two main types of elements offered at present and both have their good points. The most popular type consists of a single nichrome wire, insulated and lead covered, which is designed to be buried in the soil 4 to 6 inches below the surface. The conductor used has a resistance of 0.5 ohms per foot and when 60 feet is connected across 110 volts it gives a 400-watt element. This amounts to 6.7 watts per foot which is not a hot wire element and when buried in moist soil the heat is gradually dissipated throughout the soil. The 60 feet of lead-covered cable gives a very flexible element, which can be laid out with any desired spacing without causing "hot spots" in the soil.

The other type of element consists of an open, low temperature resistance coil, strung on a light frame. The whole unit is slid into a special air compartment immediately below the growing soil. This type of heater had the advantage of supplying the heat directly to the air, not being hindered by the lead covering; also the whole element can readily be removed and used elsewhere. However, the necessity for special air space under the bed tends towards higher heat losses and has the aforementioned bad effects of bottom insulation.

### Capacity Required

The size of heating elements required of course varies according to the size of the hotbed and can best be dealt with in terms of heating capacity or heat flux required per square yard of bed. The installed capacity generally recommended to safely cover Canadian weather conditions is 100 watts per square yard. The capacity actually necessary depends upon the average difference in temperature

inside and outside the frame and a factor of safety to allow for weather conditions such as high winds or sudden frosts. Data obtained from experiments using 100 watts per square yard shows that in the greenhouse the heaters were only in use 30 per cent. of the time. From this it is obvious the same heating elements could have been spread over double the area and still have an ample factor of safety for greenhouse work.

Similarly for a fairly well constructed hotbed, while the factor of safety has to be larger because the bed is exposed to outdoor temperature, the whole unit is more enclosed and therefore holds its heat longer. In one test it was found that with an outdoor temperature ranging from 26 to 32 deg. fahr. during the night with a fairly strong wind, 100 watts per square yard maintained a temperature of 70 degrees in the hotbed without any difficulty, the heat being on only 60 per cent. of the time, leaving 40 per cent. unused capacity. Opinions would no doubt differ as to whether to leave this unused capacity as a factor of safety for temperatures below 28 deg. fahr. or to cut down the capacity and allow the temperature in the frame to fall below the thermostat setting if the outside temperature falls below 26 degrees. From the author's experience it is preferable to spread the element over more area and use more nearly its full capacity. The larger crop raised would more than offset any setback there might be on account of temperature dropping say from 70 to as low as 40 degrees for a few hours during an exceptionally cold night. This method is sure to meet with the approval of the grower because he will not require as much equipment to heat his frames, the power company will be benefited by less peak load but the same or more kilowatt-hours, and the manufacturers of the equipment will also benefit in the long run, if not at first, because the biggest obstacle in selling electric soil heating is the initial outlay for equipment.

The general opinion of a meeting of representatives of several power companies and government engineers recently held in Hamilton was that the recommended heat flux could safely be reduced to 60 to 75 watts per square yard for spring and fall use, rather than 100 watts as was originally recommended.*

### THERMOSTATIC CONTROL

Large variations in temperature from day to day and between night and day necessitate regulation of the amount of heat supplied at different times. This checking and regulating can be done manually by means of a four-way switch, and the electric heat will still be ahead of the manure heat, but the fact that it can readily be done automatically by means of a thermostat is where electric heating shows its real superiority. The electric thermostat is on the job twenty-four hours a day to give the soil just as much heat as it requires and no more.

Thermostats especially designed for soil heating are equipped with a soil bulb which is connected to the thermostat by means of a capillary tube. This bulb is quite sensitive and will actuate the thermostat when the temperature varies about 3 de-

* This action was not intended to include greenhouses.—*Bulletin Editor.*

grees above or below the thermostat setting, making an operating range of 6 degrees at the soil bulb which is hardly noticeable at the surface of the soil.

These thermostats are reliable and at their present price are not too expensive if their full capacity, 2,800 watts, can be utilized. However, for smaller installations, which must be sold first to introduce the larger ones, a smaller and cheaper thermostat would help. A thermostat large enough to control 1,000 watts would suit small installations or smaller units of a big installation. Even large installations are better controlled in smaller units as this gives a factor of safety to allow for failure of any one thermostat. Also different temperatures in different parts of the same bed may be desired to force or retard that portion of the crop.

### INITIAL COST

It would be difficult to compare the initial cost of the two types of elements and also rather unnecessary, since more recent improvements have caused the lead-covered cable to be almost universally adopted as the most efficient and adaptable means of supplying the heat to the soil.

This equipment should give service for several years without further cost.

### RESULTS

In all types of crops, both vegetable and flower, faster growth without sacrificing sturdiness of plant or strength of roots is the aim of electric soil heating. By maintaining the soil temperature higher than the air temperature the effect is first shown in more vigorous root growth which soon results in stronger foliage and finally choicer fruit. Some types of crops will not stand quick forcing to full maturity but can be given a flying start and then encouraged at a slower rate to allow proper maturity. As much as 50 per cent. of the time can be saved in germinating practically all seed, but after germination the temperature must be lowered somewhat to conform with the former habits of the plant. When this is done as high as 33 per cent. saving in time between germinating and transplanting into the field or garden is effected. Short season crops such as radish, lettuce, cucumbers, etc., which can normally be matured in six to twelve weeks, can be forced to maturity with soil heat in from four to nine weeks. As an example, in Vancouver cucumbers were matured one month earlier, thereby collecting $1 per dozen more by being on the market before the normal crop. In California 1/10 acre of cucumbers in the field were heated electrically and maintained 25 degrees higher than a similar unheated plot. The heated plot matured in forty-one days, a month earlier than the check plot, and yielded twice as many cucumbers with an additional $150 revenue from the plot, against which was charged 2,400 kw-hr. at 1 cent per kilowatt-hour or $24.

In the propagation of cuttings, much time can be saved because here the primary concern is the forcing root growth. For this reason the heated bench is not boxed in, only the soil being heated, the air temperature being more or less governed by the greenhouse temperature. But more important than the saving in time is

that a very much higher percentage of the cuttings will take hold. This is to a large extent due to the fact that the soil, being warmer than the air, evaporates moisture at the surface rather than condenses it, as takes place when the air is losing heat to the soil. This automatically prevents black leg and stem rot, diseases very common to the propagating bench. The lower air temperature also discourages the development of aphis and other forms of insect life which menace the foliage of many plants.

Many of these improvements cannot be evaluated accurately in dollars and cents but will not be ignored by growers who are looking for ways of meeting keen competition and of outwitting backward or unfavourable seasons.

To what extent these results can be applied to local conditions can only be answered by trying them out locally. Sponsored by the Winnipeg Electric Company, first hand experience with electric soil heating was obtained at the Tomlinson greenhouses, Bird's Hill road, where a 400-watt, lead-covered heating cable was installed on the greenhouse bench. The temperature was controlled by means of a small water heater type thermostat. At list prices, the total cost of equipment was approximately $13. The bench was used for the germination of expensive varieties of flower seeds, the aim being to improve the percentage germinated. The power was turned on February 18th and was operated along with a check bench exactly similar but without electric soil heat. By March 10th, twenty-two days, several batches of seed were germinated. The bench was kept at a minimum of 70 deg. fahr. The average temperature of the check bench was 55 deg. fahr. The power used was 45.3 kw-hr. in twenty-one days, or 2.1 kw-hr. per day.

### Electric Soil Heating in the Cold Frame

When the propagating season was over, about March 30th, the same equipment, heating cable and thermostat, was utilized as a prevention against sudden frosts in the cold frame. In this instance the object was to supply just sufficient heat to

GERMINATION TEST RESULTS

| Variety | Time Germ. Htd. Bed | Time Germ. Chk. Bed | Percentages | | | |
|---|---|---|---|---|---|---|
| | | | Germ. Htd. Bed | Germ. Chk. Bed | Damp Off Htd. | Damp Off Chk. |
| Lobelia | 4 days | 7 days | 90 | 75 | 0 | 20 |
| Pansies | 6 " | 6 " | 75 | 75 | 0 | 0 |
| Balsam | 4 " | 6 " | 100 | 80 | 0 | 30 |
| Verbena | 5 " | 7 " | 90 | 65 | 0 | 10 |
| Coleus | 7 " | 12 " | 80 | 40 | 5 | 30 |

keep the temperature a few degrees above freezing; thus the 60 feet of cable of 400 watts heating capacity could be spread over a larger area. In this case it was strung around the perimeter of a cold frame 7½ feet wide and 22 feet long. The thermostat was set to go on at 36 deg. and off at approximately 46 deg. fahr. While no autographic record was kept of the number of times the apparatus was in service, there were at least three nights within two weeks that the electric heat came on and prevented damage by frost; which is proved by the fact that frost was evident in other cold frames even though they were covered with heavy carpeting.

By stringing the heating cable around the sides of the cold frame, close to the glass, heat was supplied close to the source of most of the cold draughts, thereby pre-heating the air entering the frame before it spread or did any damage. At the same time this allows the cable to service more area, keeping down the cost per square yard for equipment.

### Electric Soil Heating in the Greenhouse

The soil heating equipment used in the cold frame, and previously on the propagating bench, was now moved back into the greenhouse to be used in the forcing of cucumbers.

The 60 feet of cable was buried along each side of a row of cucumber plants, when they were transplanted from boxes to the greenhouse bench. The cable was laid three inches below the surface of the soil, and approximately five inches from the row on each side. The 60-foot length serviced twelve plants; as a check the row of plants continued further but without any soil heat.

The thermostat was set to turn the heat on when the soil temperature

POWER USED

| Date | Hours on (Approx.) | Kw-hr. Used | Kw-hr. Per Day | Remarks |
|---|---|---|---|---|
| May 18th to 25th..... | 32 | 13 | 1.85 | Heat on 3.5 to 5.0 hours per per day. |
| May 25th to June 1st.. | 28 | 11.2 | 1.60 | Marked difference in size htd. plants in bud. |
| June 1st to 14th...... | 40 | 16.0 | 1.23 | Small fruit in htd. plants. Chk. plants in bud. |
| June 14th to 24th..... | 24 | 9.7 | 0.97 | Htd. plants clipped to stop growth, force fruit. |
| Total—37 days.... | 124 hours (3.4 hr. per day) | 49.9 | 1.35 | Weather exceptionally hot for June. |

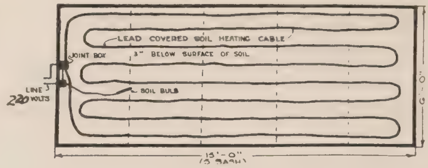
dropped to 56 degrees, turning off again at about 67 degrees, thus maintaining an average of approximately 62 deg. fahr.

Although quite warm weather prevailed throughout the test, the heat came on almost every night from May 18th to June 15th and occasionally up to June 24th.

The spring of 1933 will be recorded as an exceptionally good growing season, weather conditions being about a month advanced compared to other years. For this reason the check plants with natural conditions showed quick growth and the artificially heated plants did remarkably well to show superiority in size and quality. With average June weather the difference would be more noticeable and the equipment would have been used for more hours each day.

### HOTBEDS

The principal use of soil heating, however, is the electric hotbed. Here electricity replaces manure as a source of heat. In order to give it a fair trial both an experimental installation and a practical farm installation were started last spring. The experimental installation was operated by the Agricultural College, the main object being to test out a standard electric hotbed under local conditions. The bed was laid out with the recommended heat flux of 100 watts per square yard, which was supplied by 120 feet of lead-covered cable buried 6 inches below the surface of the soil. The temperature was controlled by a soil heating thermostat with the soil bulb also buried in the soil. With the thermostat set at 70 deg. fahr. no difficulty was experienced in main-




*Five sash hotbed, 120-ft. heating cable.*

taining this temperature in the soil, but it was found that the air temperature fell to as low as 36 degrees even though the lower soil was above 70 degrees. This was mostly due to too heavy a layer of soil above the heating cables, preventing the heat from rising to surface fast enough to replace heat lost through the glass.*

Benefitting by this experience an installation of 16 square yards area was installed at the Tomlinson greenhouses. This bed was laid out with a heat flux of 75 watts per square yard supplied by lead-covered cable buried only 3 inches below the surface. In order to further insure against too great variation between soil and air temperatures another 25 watts per square yard heat flux was supplied in the form of 50-watt tungsten lamps suspended from the ribs which supported the sash. It was found that with the heating cables nearer the surface the auxiliary air heating was not necessary, the largest variation between soil and air temperature being 10 degrees. This small difference is not of any consequence and would not warrant special air heating equipment and could be further reduced by placing the heating cables still closer to the surface.

The first crop grown in this bed consisted of radish, spinach and leaf

* It was also probable that moisture content in soil was too low.—*Bulletin Editor.*

## COMPARISON OF HEATED BED AND CHECK BED TEMPERATURES

| Date | Outside Temp. Deg. Fahr. | Thermostat Setting Deg. Fahr. | Soil Temp. Deg. Fahr. | Air Temp. Deg. Fahr. | Check Bed Temp. Deg. Fahr. | Notes |
|---|---|---|---|---|---|---|
| Apr. 12 | | | | | | |
| a.m. | 19 | 70 | 67 | 62 | 24 | Radish showing (2 |
| p.m. | 25 | 70 | 68 | 68 | 37 | days). |
| Apr. 15 | | | | | | |
| a.m. | 27 | 70 | 55 | 62 | 30 | Thermostat not on. |
| p.m. | 45 | 70 | 70 | 72 | 55 | Lights on full time. |
| Apr. 19 | | | | | | |
| a.m. | 30 | 70 | 68 | 67 | 36 | New thermostat |
| p.m. | 42 | 70 | 71 | 76 | 50 | put in service. |
| Apr. 23 | | | | | | |
| a.m. | 40 | 65 | 63 | 62 | 46 | Radish showing in |
| p.m. | 65 | 65 | 70 | 78 | 75 | check bed (4½ dys.) |
| May 1 | | | | | | |
| a.m. | 46 | 65 | 66 | 62 | 60 | Pulled sample of |
| p.m. | 60 | 65 | 75 | 80 | 75 | radish electric bed (19 days) |
| May 8 | .. | .. | .. | .. | .. | |

Thermostat only on about three hours each night.

lettuce, which were seeded on April 10th. The radish were fully germinated in three days, thinned out on the seventh day and were harvested between May 9th and May 12th. The manure hotbed, operated as a check bed, took five days to germinate, needed no thinning out, and the first radishes were pulled May 18th.

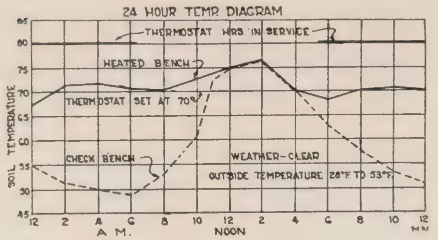
Between April 15th and April 19th, thermostat trouble caused temperatures in soil to drop too low at night; the lights were switched to a separate circuit so that they could be left on regardless of the thermostat. This supplied sufficient heat to keep out frost while obtaining a new thermostat.

In figuring the average, the period from April 15th to 19th was not considered, since the thermostat was out of order.

The total energy used to grow a crop of radish and spinach in twenty-nine days was 392 kw-hr. or about 14 kw-hr. per day for 16 square yards of bed.

### Improvements from Experience

Every year has seen improvements in the construction of beds, types of




*Comparison of temperature in unheated greenhouse bench, February 10th, 1933.*

elements and their location in the soil, thermostats and also in the price of power supplied. All have helped to built up an increasing margin of superiority for electric soil heating.

There is still considerable argument as to where the element should be placed—deep in the soil, just below the surface, or at the surface.

Repeated tests by the National Project and co-operating growers during the past winter and spring have shown that surface heating is entirely practical in hotbeds and cold frames. By applying the heat directly at the point where it is most needed, power consumption has been reduced and the need for special insulation and laborious or expensive construction obviated. Any hotbed which is well drained, protected from winds, and free from cracks and openings may be made into a satisfactory electric hotbed by laying electric soil heating cable on the soil surface at the time the seeds are planted.

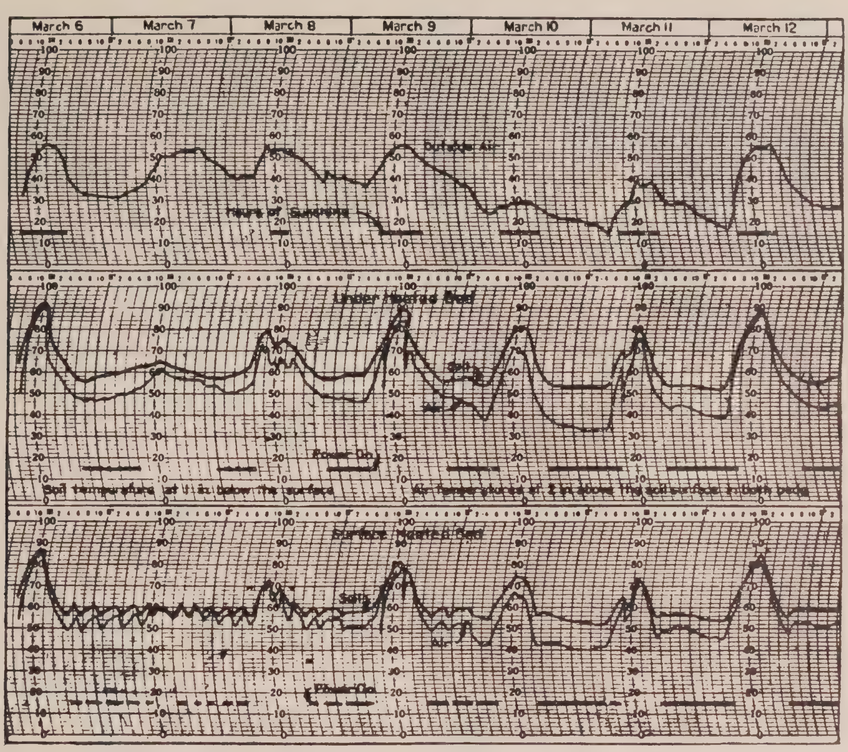
Plants grew in contact with the heating cables without injury. Germination was quicker, plants grew faster, and in the tests reported the plants were sturdy and had larger root systems. Power consumption was considerably reduced during mild weather, and because of the quicker response to falling temperatures there was better protection from frosts and higher night temperatures during periods of cold.

POWER CONSUMPTION

| | Outside Temp. Deg. Fahr. | Hotbed Temp. Deg. Fahr. | Kw-hr. per day | Kw-hr. per sq. yd. per day | Hours on (average) |
|---|---|---|---|---|---|
| April 10th to 15th..... | 27 to 45 | 70 | 20.1 | 1.25 | 12 |
| April 15th to 19th..... | 26 to 50 | 60 | 5.2 | 0.33 | 24 (Lights only) |
| April 19th to 24th..... | 30 to 60 | 68 | 15.7 | 0.98 | 9.3 |
| April 24th to May 1st. | 46 to 65 | 66 | 14.3 | 0.89 | 8.4 |
| May 1st to 8th...... | 40 to 64 | 64 | 13.1 | 0.85 | 7.7 |
| Average 25 days.. | 26 to 65 | 66 | 14.85 | 0.93 | 8.7 hours |

(1)

(2)




*Outdoor soil and air temperatures.*
*(1) Underheated hotbed.*
*(2) Surface heated hotbed.*

The lead-covered element seems to be reliable, flexible and durable, and its heat flux of 5.7 watts per lineal foot is ideal where 100 watts per square yard is used. However, with a reduction to 60 to 70 watts per square yard an element of 5 watts per lineal foot would spread the heat better.

One of the methods of saving power in any type of electrically heated hotbed is to cover the beds with mats at night. In an eight day cold weather test burlap bags filled to a thickness of 4 inches with straw resulted in a saving of 33 per cent. in the power used in an identical bed without mats. Double glazing of the sash proved to be almost as effective for conserving the heat of the beds. The double glass was effective for twenty-four hours each day whereas the mats could only be used at night.

Persistent inquiry into the matter of thermostats has failed to produce a soil heating thermostat at a price suitable to smaller installations. Capacity and sensitivity could well be sacrificed to keep the thermostat cost down to not more than equal the cost of the equipment it is to control.

Many European installations still use manual control, generally a four way stove switch giving three different heats on any installation of over

800 watts capacity. While this system has all the inherent disadvantages of manual control, it lends itself admirably to special night rates for power. Power Companies in many cases find that they can more profitably supply off peak load at half price rather than install new distribution equipment to supply twenty-four-hour demand. For Example:—in Norway power can be used between 6 p.m. and 7 a.m. at from 0.4 cents to 0.6 cents per kilowatt-hour. A study of our own charts from the newer type of hotbed indicates that 90 per cent. of the time the soil heating load automatically confines itself so these hours.

In conclusion it is suggested that the following points require further study, namely:

(1) The proper soil and air temperatures required for various plants and for various stages of plant growth.

2. The proper electrical capacity to maintain good growing conditions under different weather conditions.

3. A comparison of manual and thermostatic control under local conditions.

4. The use of electric light to vary the length of day, in conjunction with electric soil heating.

5. The best method of selling electric soil heating to the grower.

The electric hotbed is not a luxury —it is an agricultural tool designed to make the work of the grower more pleasant, more efficient and more profitable.

Generally speaking a large installation can be made at a lower cost per bed than a small one, and if one bed can justify itself economically it follows that several should be even more profitable.

There is undoubtedly a splendid field for electric soil heating in Canada. This is evidenced by a summary of operation of electric hotbeds by the Shawinigan Power Company for 1933, which shows twenty-two installations totalling over 2,000 square yards of beds which used 50,000 kw-hr. during the early spring season. It is to be hoped that there will be a continuation of the splendid co-operation and interchange of experience amongst all who are engaged in its development.

NOTE:—The author desires to acknowledge the co-operation of Professor F. W. Broderick, Professor of Horticulture at the University of Manitoba, and of Mr. L. M. Cochrane, of the Cochrane-Stephenson Company. Also information and data taken from the following publications:

"Promoting Plant Growth by Electrically Heated Soil", by O. W. Titus of the Canada Wire and Cable Co.

"Profitably Turning Kilowatts into Cucumbers" by W. F. Mainguy, Power Sales Engineer, Shawinigan Water and Power Co., Montreal.

"The Electric Hotbed; Its Construction and Operation," by S. Bowman of the British Columbia Electric Railway Co.

"Electric Hotbeds and Propagating Benches", (Report No. 6-1932) and "Electric Soil Heating" (Report No. 8-1933) by the National Rural Elec. Project of U.S.A. College Park, Maryland.

* * * *

From *World Power* we have the following short report regarding studies of temperature rise by electric heating of the soil.

Whilst plant treatment with ultra-violet light is in the experimental stage, soil heating by the electric cable is now a commercial proposition with advantages that are widely recognized, and is, consequently, electricity's most important contribution to horticulture. The importance of

disseminating accurate information with regard to the most economical methods of utilizing the electric cable cannot be too often stressed at the present moment. In this connection we welcome the publication by the W. T. Henley's Telegraph Works Company, Limited, of a booklet on soil heating which gives really valuable information based on work done at the Henley research laboratories.

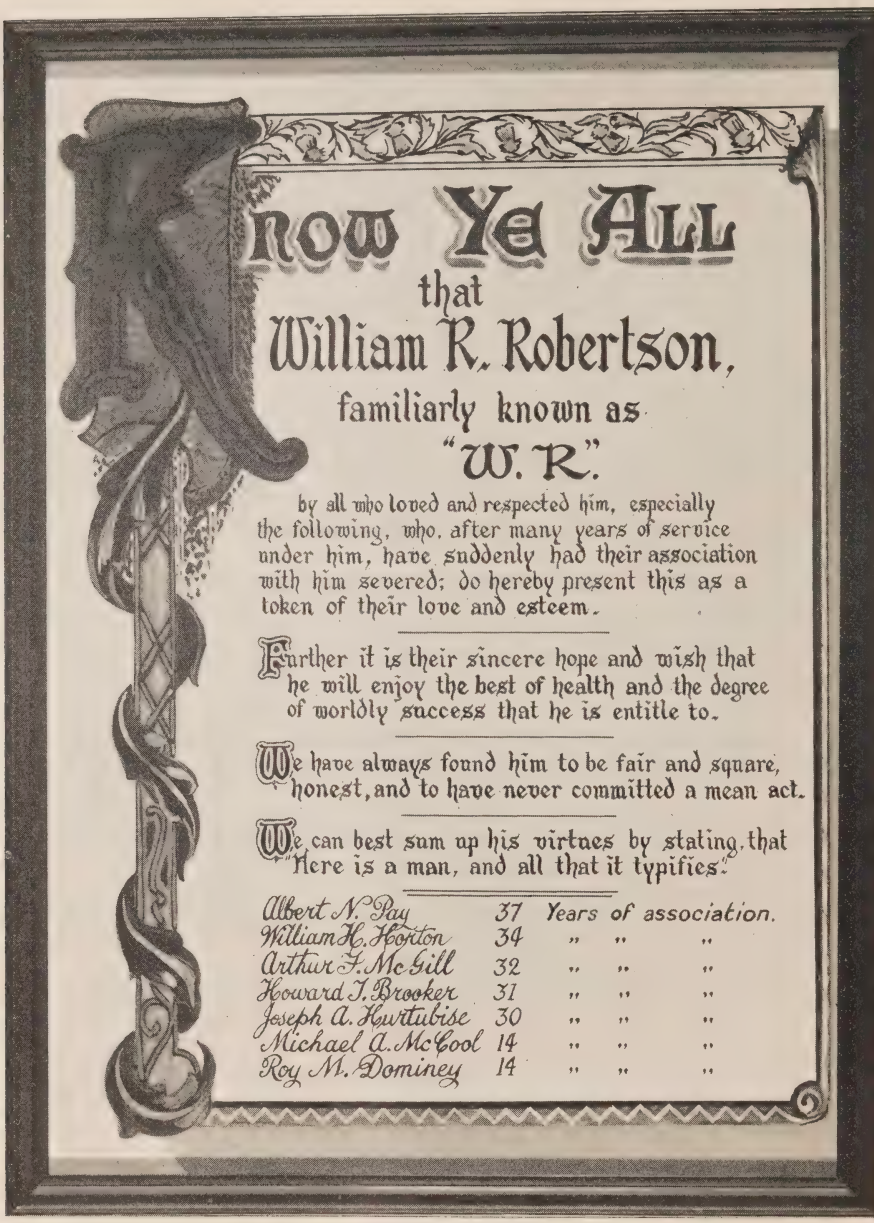
The standard length of cable supplied by this company is 50 yards on the standard voltage. Cables with three degrees of heating capacity are provided: 1000, 750, and 500 watts respectively. The standard length of 50 yards of cable suffices to heat 16 square yards of soil. The following table shows the anticipated temperature rise and power consumption with the standard 50-yard lengths of the respective cables supplied:

The figures in the table represent the increase of the soil temperature above that of the atmosphere, in a sunk bed of sandy loam with 15 per cent. moisture content.

The time required to heat a bed of 16 square yards would be approximately 16 hours, but this is of course dependent on the efficiency of the methods of heat insulation adopted. After warming up, the soil loses its heat very slowly. The 750-watt cable will deal adequately with 16 square yards of soil in cold weather only if left on for the full 24 hours. For short period heating the area covered by one cable should be reduced proportionately.

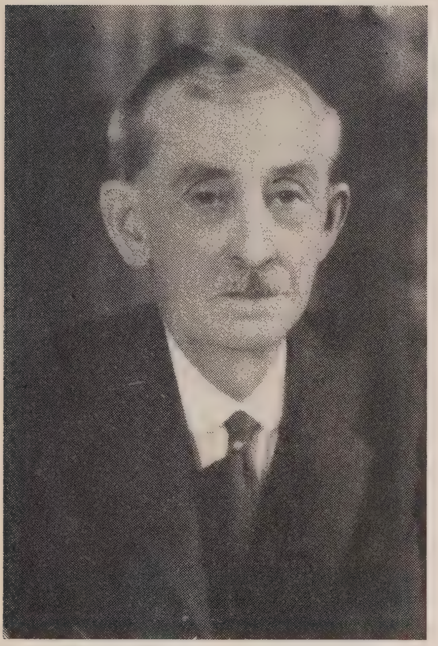
The methods of installation are exceedingly important and must be designed to reduce the heat loss to a minimum. The power consumed in maintaining the temperature will depend on the efficiency of the heat insulation of the frames or houses. The importance of these remarks will be better appreciated when it is borne in mind that 60 per cent. of the heat is lost through the bottom and sides of a raised bed which is uninsulated, whereas with a properly constructed, i.e. efficiently insulated, sunk bed the heat loss is reduced to 10 per cent.

| Cable Rating Watts | Mean Temperature Rise Deg Fahr. Above Air | | | | Power consumption kw-hr. per sq. yd. per 24 hrs. continuous running |
|---|---|---|---|---|---|
| | Surface | 3 in. depth | 6 in. depth | 9 in. depth | |
| 1000 | 15.0 | 21.0 | 27.0 | 33.0 | 1.10 |
| 750 | 11.0 | 15.5 | 20.0 | 24.5 | 0.83 |
| 500 | 7.5 | 10.5 | 13.5 | 16.5 | 0.55 |




*The Sandwich, Windsor and Amherstburg Railway which has been operated since 1921 by the Hydro-Electric Power Commission of Ontario, under the direction of W. R. Robertson, was formally transferred to the municipalities on September 22, 1934. A number of the employees of the road, who had been associated with Mr. Robertson for many years, took this opportunity to show their esteem for him by the presentation of an all-wave radio and an illuminated address.*

## Congratulations



*Major W. W. Pope*

On October 9, 1934, W. W. Pope completed twenty-five years of service as Secretary of the Hydro-Electric Power Commission of Ontario. The Bulletin takes this opportunity of extending to him, the Young Grand Old Man of the Hydro staff, hearty congratulations on his excellent record.

Mr. Pope was born in Compton County, Quebec, being of United Empire Loyalist descent, and it was here he received his early education. As a young man he joined the staff of the Boston, Clinton and Fitchburg Railway, Boston, Mass., where he served for about four years. Later, in 1874, he took up the study of law at Belleville, Ont. In 1876 he became assistant to the late John Bell, Q.C., solicitor of the Grand Trunk Railway, where he remained until 1905, where he was transferred to Montreal as assistant to W. H. Biggar, K.C. In 1909, Mr. Pope became solicitor and secretary of the Hydro-Electric Power Commission of Ontario, where he still serves in the latter capacity. He holds the rank of Major in the 15th Regiment, Belleville, Ont., from which he retired in 1909 with a long service decoration. He also hold a decoration as a veteran of the Fenian Raids.

It is our wish that Mr. Pope may be blessed with health and strength and enjoy life for many years yet to come.

# A. M. E. U. CONVENTION

## *at* ROYAL YORK HOTEL, TORONTO

### JANUARY 29 and 30, 1935

# Protection for the Eyes and Body from Welding Rays

By W. D. Walcott, Inspecting Engineer, H.E.P.C. Laboratories

DURING the operation of arc welding, two types of invisible rays are projected from the arc., viz.:

1. Ultra Violet Rays;
2. Infra-Red Rays.

These rays have one characteristic in common with many poisonous drugs, such as arsenic and strychnine, in that while in small doses they are beneficial in combatting and curing certain diseases, in excessive quantities they are distinctly harmful to human health. These rays exist in sunlight, but the atmosphere reduces their intensity by diffusion. They are also emitted by the well-known sunray lamp, which has become quite prominent in the treating of various skin and other diseases. Both the violet and infra-red rays are very harmful to the eyes, causing irritation and pain, and if the skin is over exposed to them, the time depending on the proximity of the source of the rays, the effect will be very similar to that of severe sunburn.

By studying the anatomy of the eye, it can be seen how the rays affect the eyes. The three chief parts of the eye are the iris, the lens and the retina. The iris is a small circular muscle which opens and shuts in the centre and controls the amount of light admitted. The lens focuses the image upon the retina from which it is taken to the brain by the optic nerve.

If the eye gets more light than it can stand, the result is impaired vision. As the light is intensified during welding the mechanism of the eye does not allow its absorption. The eye must, therefore, be protected from the ultra-violet and infra-red rays and the amount of visible light must be cut down.

The ultra-violet ray irritates the skin and is harmful to the eyes. It is considered to be the least harmful of the two.

The infra-red ray is a heat ray. Its action is slow. Long exposure will result in severe damage to the cornea or outer covering of the eye and may result in grave and permanent injury to the eyesight. The problem then is to devise means of protecting the eyes and other parts of the body which might be exposed during welding, from the injurious effects of these rays.

First, the dangerous rays must be excluded; and secondly, the material used to exclude these rays must be such that it will not distort the welder's perception of colour.

Glass has been found to be the most satisfactory medium of providing the necessary protection, and iron which is the only element which will exclude these rays, is incorporated in the manufacture of welding glass. Welding glass is made in various shades depending on the amount of current used during welding and the higher the current the darker will be the shade of glass required. These welding glasses are inserted in a helmet or a hand shield which, in

*Welding Goggles.*

addition to protecting the eyes, protects the face and neck. The other parts of the body are protected by clothing and the hands are protected by suitable gloves. Manufacturers of welding glass have given shade numbers to the various densities of glass, the density being the measure of the power of the glass for absorbing visible radiation.

The following numbers have been given by the manufacturers and have been found suitable for the different types of radiation:

| *Shade No.* | *Use* |
|---|---|
| 3 | Light brazing work. |
| 4 and 5 | Glasses to give protection from Sun Ray Lamps. |
| 6 and 7 | Light acetylene welding, cutting and brazing. |
| 8 | Heavy acetylene welding. |
| 10 | Metallic Arc up to 250 amperes. |
| 12 | Metallic Arc over 250 amperes. |
| 14 | Carbon Arc welding and cutting. |

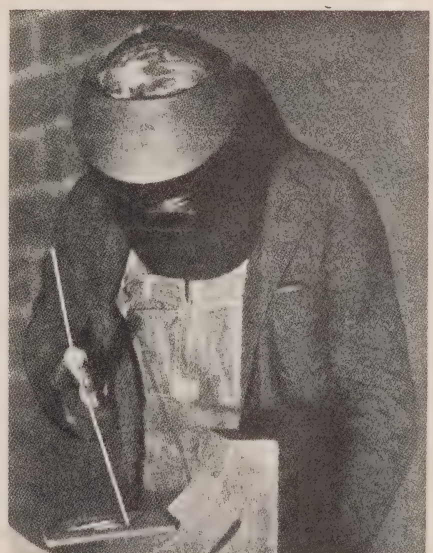
In welding shops, however, the welder is not the only individual who has to be protected from welding rays. There are always workmen and helpers who are in the vicinity of the welders and they are often exposed to the harmful rays. How can they be protected?

1. By the use of suitable partitions in the welding shop which will completely isolate the welder and keep the rays from being reflected outside of the cubicle. These cubicles may be cheaply constructed by placing curtains on pipe frames made portable by mounting them on wheels.

2. By the use of folding screens. These devices have been found to be particularly handy where small jobs are being welded in position on a machine which is too large to be taken to the welding cubicle.

3. By providing the welders with suitable lenses for their helmets, and the workmen with goggles which will protect their eyes and yet provide them with sufficient visibility to enable them to carry on their work.

4. By painting the walls and partitions of the welding shop with a flat black paint, so that the effect of reflection is reduced to a minimum. It is quite possible for a welder to



*Welding Shield.*

be burned by reflections from a bright wall surface, on the back of the neck and the back of his ears. Instances have been known where workmen who have been working in the vicinity of welders for periods of six or eight hours, have afterward suffered from irritation of the eyes. These men did not look directly into the arc but were affected by the reflection of its rays.

*Remedies for Eye Flash*

In all large welding shops there are usually remedies provided in the First Aid Departments, for irritation of the eyes from exposure to welding rays or "Eye Flash" as it is sometimes called. In some of the smaller shops there is no such provision. Amongst the most effective used are Butyn, and a weak solution of Hydrochlorate of Cocaine, which may be used by itself or in combination with boric acid. These remedies, however, have to be obtained on the prescription of a physician. Amongst the best known home remedies are castor oil, a weak solution of common salt and water, and cold compresses made of tea leaves steeped in water. All of these remedies have been found helpful.

*Inspector's portable hand shield.*

*Welder's hand shield.*

*Conclusions*

In all welding shops steps should be taken to prevent injuries to the eyes of welders and others. These precautions may be divided into two main classes:

1. The providing of suitable protective equipment for welders and workmen;

2. Education of the men to exercise the necessary care which will protect themselves and others from possible harm.

It should also be remembered that by giving the workmen the necessary protection, less time will be lost and a higher grade of work will be produced.

# THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


## Picton Public Utilities

THE story of the Town of Picton, leading up to the formation of the Public Utilities Commission, covers a period of over one-hundred year. It was in the year 1797 that the Township of Hallowell, Prince Edward County, was incorporated, at which time there were two village settlements at the head of Picton Bay, known as Picton and Hallowell. In 1837 these two villages were incorporated in the Town of Picton to be governed municipally by a Board of Police Commissioners. This continued until 1849 when the town was given the power to elect a Town Council, and in 1850 the first Council was elected.

The first step toward the municipal operation of public utilities was taken in 1860. In that year a street lighting system was put in operation, when the Town Council caused to be erected on the corners of streets intersecting the main street, posts about eight feet in height, each with a square clear glass lantern enclosing a coal-oil lamp. The market clerk was appointed lamp lighter, whose duties were defined, in brief, to keep these lights trimmed and burning during certain hours of darkness each night throughout the year.

In the fall of 1889 electric street lighting was first installed, as also electric lighting for commercial and domestic purposes. The street lighting system consisted of fifty 1000 candlepower arc lamps, while twenty-five 1000 candlepower arc lamps were placed in stores. Incandescent lighting was provided for other commercial and domestic uses.

During the same year, 1889, the waterworks system was started, which was for fire protection purposes exclusively. Within the next year applications were made to the Town Council for a lawn service, which soon spread to an inside tap service.

The control of both the light and water services was invested in a committee of the Town Council from year to year, until the year 1900, when the electors approved of a by-law to place this control in the hands of a commission of two to act along with the Mayor. The commissioners were elected for a two-year-term, alternating one each year.

In April, 1919, the Public Utilities Commission shut down its steam

## CONTENTS

**Vol. XXI** **No. 11**

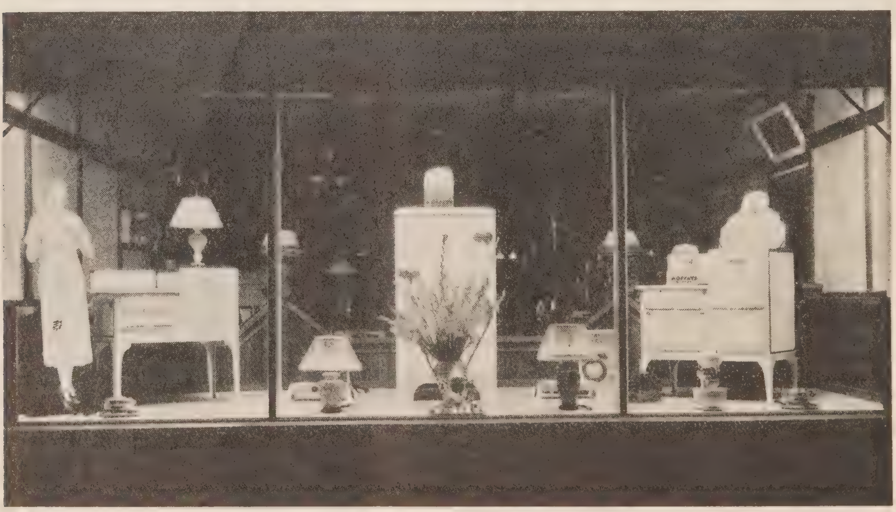
**NOVEMBER, 1934**



plant and commenced using Hydro power. In that year the electric utility served 805 consumers and had a load of about 200 horsepower. By 1933 the number of consumers increased to 1239 and the average load taken was over 770 horsepower. All property controlled by the Commission, both for water and electric service, is free from debt.

Up to this year the Commission has been housed in rented quarters used for offices and Hydro Shop. As this required the payment of substantial sums of money each year for rent, it was decided in 1933 to look for a suitable building to be purchased. As a result a building in the heart of the main business section was obtained at a very reasonable price and paid for out of accumulated funds on hand. The building though erected in the early 1860's was in excellent repair and admirably suited for Hydro Shop and office purposes. It is a three-storey structure of red brick, 40 feet in width on a 50 foot frontage, facing on the main street. All necessary alterations were completed and the building was ready for occupancy by July of this year.

The Town of Picton is to be congratulated in having a Public Utilities Commission whose members in the succeeding years have been select



*Hydro Shop window, Picton P.U.C.*

men, qualified in every way for public business. They have continued a state of advancement in the quality and standard of electric and water services and have thereby maintained the full confidence of both the Town Council and the citizens. The Commission officers for this year, who had the responsibility of the alterations to the building and to whom much credit is due are—Messrs. H. B. Tully, Chairman; George Welch, Commissioner, and Everett P. Cox, Mayor; William Tait is Superintendent, Secretary and Treasurer.

# Eye Damage Prevented by New Science of Seeing

## Which Promotes Health

**By G. W. Austen, Manager, Electric Service League, Toronto.**

CONTROL OF LIGHT IS POSSIBLE THROUGH MASTERY OF DEFINITE, EASY-TO-UNDERSTAND LAWS WHICH CAN BE APPLIED INDIVIDUALLY. LIGHT IS GROSSLY INADEQUATE IN OUR INDOOR WORLD ALTHOUGH BRIGHTNESS IS AN IMPORTANT FACTOR. IT IS IMPORTANT TO REMEMBER THAT WHILE LIGHTING IS REALLY A VERY SIMPLE MATTER, SEEING IS A VERY COMPLEX ONE.

THE new science of seeing affects every one of us; in our comfort, health, efficiency, appearance—in our general adjustment to life. That is because it has to do with eyes and our use of them. Consequently, it has to do with our whole physical and nervous well-being, since that is linked with our eyes and inevitably reflects their condition. This new science proves that normal, healthy eyes are dependent on the quantity and quality of light they see by.

Scientists have worked many years to evolve the principles of this new science. They have made hundreds of thousands of observations on eyes and the way people use them. They have reduced the fundamental principles of their findings to definite, easy-to-understand laws which we can all apply to ourselves.

The tasks we use our eyes for cannot be changed very much. To a great degree they are prescribed for us—from the child who has his school-room routine to the grown people who read and sew, or otherwise do close work most of the day. We have been able to change our eyes themselves only by calling upon the eye-sight specialist's skill, and, if glasses were prescribed, wearing them as we might use any other crutch. Not until the last quarter-century have our scientists realized we might go further and, as individuals, control the light by which we do all this seeing.

By knowing the fundamentals of this marvellous new science, and by applying them where we live and where we work, we can prevent or greatly help to prevent the eye damage that is now so widely prevalent.

### Preventable Eye Defects

The cost in eye defectiveness due to poor seeing conditions is the most obvious item of human expenses in seeing. But eye defects are generally ignored, except to counteract them with eye-glasses, a kindly service which eye specialists are rendering to hundreds of thousands. But can any one seriously conclude that eye defects are necessary, particularly in young people? Do we not have enough faith in Nature to believe that eyes should develop normally, as legs and arms do, through proper use? If we do not, statistics should be convincing.

Suppose we could temporarily convert the defects of eyes into defects of legs. What a heart-rending spectacle would be witnessed on any street. Every other person would limp perceptibly. Many would pass by on crutches and some in wheel-chairs. Such a parade should convince any one that much of the spectacle was due to neglect and ignorance.

### Nearsightedness

Nearsightedness is rare in infancy. But, as children reach school age it begins to increase, and from class to class the percentage of nearsightedness increases. Many receive, or should receive, a pair of glasses as a graduation present—and their thanks should be addressed to Negligence. The cause of preventable nearsightedness was mentioned in the very first paragraph of this article. Reading or performing other visual tasks within arm's reach, for long periods, is unnatural. If the conditions for seeing are poor—and they universally are—the child often unconsciously makes up for this deficiency by holding the book too close to his eyes. Type has been developed for the so-called normal distance of reading, which is commonly considered to be about fourteen inches. But this is a normal distance only from the viewpoint of convenience and comfort of arms not of eyes.

Poor lighting aggravates nearsightedness. The size of type, as far as the eyes are concerned, depends upon the distance from the eyes. At twenty-eight inches the letters on a printed page are only half as large, visually, as they are at fourteen inches. At a distance of seven inches they are four times as large as at twenty-eight inches and twice as large as they are at fourteen inches. Under inadequate light which is so prevalent indoors, the tendency is to compensate somewhat by holding the printed page closer to the eyes. A bad habit is in the making. Nearsightedness may develop. It becomes progressive through continued poor seeing conditions. A remedy is to improve the lighting, and, whenever possible, to increase the size of type and to make objects more visible by various other means. Adults should refuse to read small print for long periods, and children should not be permitted to read it at all.

### Where There Are Old People

Many who read this page have reached the so-called bifocal age. Eyes become more and more farsighted with the years. Apparently the eyes cannot focus accurately upon objects as close to them as they used to. The power of accommodation has decreased, and usually continues to decrease with the years. It is com-

monly considered that this defect is just a result of growing old; that is, the eye lens loses its resiliency.

It is not uncommon to see old persons, without glasses, holding an object at the full length of the arm in order to focus their eyes upon it. A newspaper at this distance appears as though the type were only half as large as it is at fourteen inches. Obviously glasses are needed by a person who cannot read a newspaper within arm's length. The efficacy of the glasses is obvious. Still, adequate light is also effective. For example, a newspaper held at arm's length can be read as easily at a window in the daytime as it can be read at fourteen inches under the usual meagre intensities of artificial illumination at night.

In the general neglect of lighting and other factors which contribute toward better seeing, the additional requirements of old eyes are not taken into account. The pupil of the eye is the doorway of light. Everyone knows that the aperture or shutter of a camera controls the brightness of the image on the film. As eyes grow older, the pupil becomes smaller for any given condition. On this basis alone, old persons need at least twice as much light on a printed page as young and middle-aged persons do. Considering also that their eyes have become dulled by years of use and abuse, old persons require several times as much light as young people.

### What Poor Seeing Does to You

The effects of poor seeing are so obscure and indirect that they are not ordinarily traceable to the cause. Eye defects are the most obvious costs of poor seeing, but even these seem remote from the cause. Headaches are commonly due to poor lighting and prolonged close visual work. These are unnatural conditions which produce the unnatural effect of headache. Eyes become fatigued and the results are often visible. Dizziness, nervousness and even indigestion commonly result from poor seeing. Often much of the cause is eliminated by correcting the eyes with glasses. However, throughout the world, seeing conditions are poor and superimposed upon this state of affairs is the strain of converging the eyes for long periods upon close work.

### Nervous Tension

Perhaps you recall how you perspired when making your first speech, or when under some other unusual situation. When driving an automobile over country highways in the daytime you are probably in a state of relaxation. But as traffic is entered, a degree of nervous muscular tension becomes apparent. At night on a well-lighted boulevard the tension may be of low degree, but turn into a dark or poorly lighted street and note how the steering wheel is gripped more tightly and the tension generally increases. Drive in a fog or rain for an hour and then note with what relief you reach your destination. Nervous muscular tension is fatiguing because energy is being expended. A boxer tires from being on his toes mentally, muscularly and neurally. So it is with teachers and mothers on particularly trying days. All this shows that nervous muscular tension drains human energy.

Extensive research into the problem of seeing resulted in the important

discovery that even easy tasks relating to seeing produce a definitely measurable nervous muscular tension.

This task of reading was about as easy as reading can be. It was extremely less difficult as a visual task than sewing, darning, and many common tasks in the home and elsewhere.

### Inadequate Light Impairs Eyesight

Our eyes are not better than those of our most remote ancestors. Yet to-day we are using our eyes for severe visual tasks 30 per cent. more than was common a generation ago. And most of this work is done, not in daylight, but indoors by inadequate artificial light.

That is one of the principal reasons why we have eyestrain. Most of us have never had enough light indoors. Now, for the first time, we are able to recommend the value of light required for any given visual task. The recommendations below are based on twenty years of scientific study. Read them carefully, for they may help to protect your entire family from impaired eyesight.

### Reading

Single-socket floor and table lamps used for ordinary reading should employ a 75 or 100-watt bulb—the 75-watt bulb only in the case of the single-socket bridge lamp. Lamps with two sockets should be equipped with two 60-watt bulbs, while three-socket reading lamps should carry three 40-watt bulbs. Wherever possible place the portable lamp so that the lamp bulbs are not appreciably more than 30 inches from the page. The shade should be light coloured inside, open at the top so that some of the light may escape to the ceiling and be reflected from it, and deep enough to hide the bare bulbs from the eyes when reading. It is advisable to have some light from other lamps or fixtures in the room when reading. This reduces sharp contrasts which otherwise exist.

### Reading in Bed

You can read in bed to your heart's content if you'll give care to two things—your posture, and the light you read by. Select your lamp carefully, making sure it throws the light directly on the book—and not in the eyes. There are several types of lamps which meet this need—floor lamps, bedside table lamps, the new inexpensive lamps that can be hung on the wall over or beside the bed. Use a lamp bulb of from 60 to 100 watts, since the lamp is ordinarily close to your book.

### Sewing

Sewing is one of the hardest tasks in the home. For even the simplest kinds of sewing, you should have a total of at least 100 watts, with the bulbs not more than 30 inches away from the work. Sewing on dark cloth with dark thread, such as darning socks, requires more light than ordinary sewing. Remember, have the entire room moderately well lighted in order to avoid bad contrasts.

For bridge and games requiring close seeing, it is important to have general illumination as well as good light on the game itself. If we play cards on a brightly lighted table and the rest of the room is dark, the contrast annoys us every time we look

up. An indirect portable lamp, in addition to ordinary floor lamps, helps to provide good light for any game. A shaded centre fixture will also assist in providing light throughout the room.

# Adequate Light for Office Buildings

By G. W. Austen

THE majority of offices are not adequately lighted for easy, effective seeing. Most of the buildings erected more than ten years ago had lighting systems put in under standards that are now obsolete. Those erected twenty years ago are woefully behind the times—unless the lighting has been modernized in recent years. The stenographers, clerks and bookkeepers who work day in and day out in those offices suffer acutely from eyestrain; in most cases, not even knowing it.

The light that seeps in from the street through the average office window is hardly sufficient, on even the clearest and brightest days, to give sufficient illumination ten feet away from the window. The lighting on desks placed close alongside good-sized windows may be sufficient around mid-day, but ten feet in from the window the volume of illumination drops sharply to a level much below that required for close work. In the majority of offices, as in stores and factories, it is desirable, and even necessary, to keep the artificial lighting on most of the day. Nearly all office work is close work, and steady work. Working on books, typing, drafting and other tasks requiring close vision is terribly trying on the eyes. Three o'clock and four o'clock lassitude and headache is a direct consequence.

Daylight out of doors, on a bright sunny day, will often approximate ten thousand footcandles. The human eye is attuned to this. Under a tree, in the shade, there will be a thousand footcandles under the same bright condition. The light outside an office window on a bright day may be several hundred footcandles. And yet, in the office the workers are expected to keep going with lighting that may not be more than five footcandles. The average office which has 20 footcandles of illumination is considered to be well lighted. Yet tests of the most comfortable volume of light for reading inside a room have shown the average person—not knowing the quantity of light being used—to prefer a hundred footcandles.

Office lighting on the whole is extremely poor. It is inadequate, not sufficiently diffused, often is marked by glare and spottiness, and extremely injurious to the eyesight of those who spend eight or ten hours a day at close work there. The reason there is so little complaint is because people do not understand the need and value of adequate, properly arranged illumination. The human eye can see an object in semi-darkness. It can see quite clearly at a distance with five footcandles of light. But for comfortable seeing, at close work, it needs many times that quantity of light.

At birth, the baby has normal eyes

in nearly all cases. Then, during childhood, he or she is taught to read. With the passing years more time in each day is put on tasks that require closeness of vision. By the time many of the boys and girls reach their teens they have developed eye weakness. In public schools about 20 per cent. of the pupils have defective vision. At college about 40 per cent. At 40 years of age 60 per cent. and at 60 years 75 per cent. Office workers are among the most sinned against of the whole industrial and commercial population, because almost their whole working time is put in working on white surfaces ten to fifteen inches away from their eyes.

It is not enough to have a special desk lamp. The human eye is injured by working in a little bright spot, and looking into the gloom, the pupil of the eye has to expand almost instantaneously to adjust itself. Doing this hundreds of times a day weakens the eye, makes it less and less able to see easily at close work. Little wonder is it that the great affliction of poor eyesight is steadily closing in on so great a proportion of commercial workers.

Office lighting is not a casual matter —something to be considered as an incidental in business. Really good illumination that provides all the requirements of the eye is an asset to a business because it not only gives the office a live, up-to-date, modern look, but it enables workers to do half as much again in a day, without feeling tired and worn out at the end. Eyestrain is nervous strain, and nervous strain cripples the efficiency of a worker.

## Footcandle Needs for Different Tasks.

In recommending the following footcandles for various common tasks, the fundamental factors of size, contrast and time have been appraised and used as a basis for the footcandles given.

One hundred footcandles or more—For very severe and prolonged tasks such as fine needle-work, fine engraving, fine pen-work, fine assembly, sewing on dark goods and discrimination of fine details of low contrast, as in inspection.

Fifty to one hundred footcandles—For severe and prolonged tasks, such as proofreading, drafting, difficult reading, watch-repairing, fine machine work, average sewing and other needle-work.

Twenty to fifty footcandles—For moderately critical and prolonged tasks, such as clerical work, ordinary reading, common bench-work and average sewing and other needle-work on light goods.

Ten to twenty footcandles—For moderate and prolonged tasks of office and factory and, when not prolonged, ordinary reading and sewing on light goods.

Five to ten footcandles—For visually controlled work in which seeing is important, but more or less interrupted or casual, and does not involve discrimination of fine details or low contrasts.

Up to five footcandles—The danger zone for severe visual tasks, and for quick and certain seeing. Satisfactory for perceiving larger objects and for casual seeing.

## Lighting Provision for the Householder.

Lamp wattages to use for good home lighting.

Porch: In enclosed overhead fixture—60-watt lamp; in bracket lantern at doorway, 40-watt lamp.

Hall: Hanging fixture—60-watt lamp.

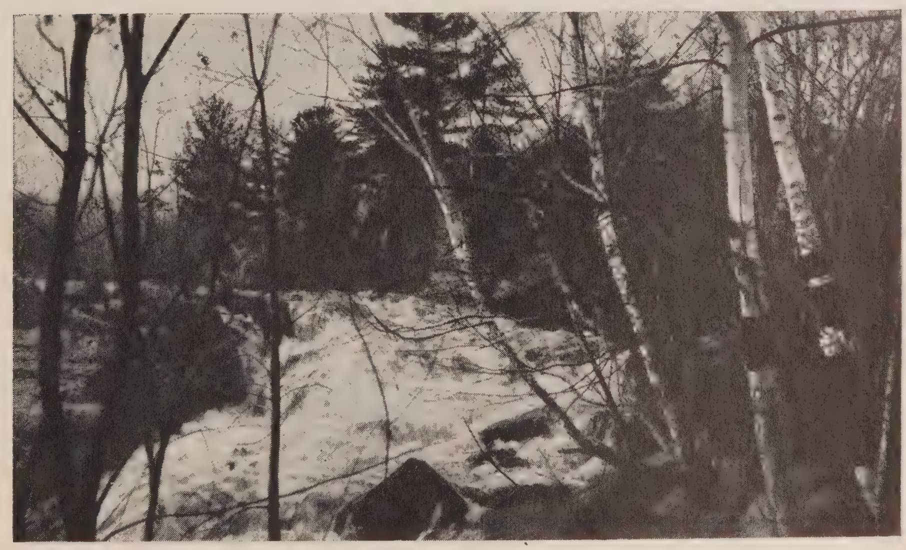
Living-room: Ceiling fixture of four or five lights—40-watt lamps. Wall brackets—25-watt flame-shaped lamps. Portable floor lamps with two sockets—100-watt lamps; more than two sockets—60-watt lamps. Indirect floor lamp for general lighting—250-watt lamp. In sockets under shades—40-watt lamps. In individual lamps for reading, sewing or writing—100-watt lamps. In table lamps with two sockets—60 watt lamps; with more than two sockets—40-watt lamps.

Dining-room: Ceiling fixture over table—clusters of four or more lights, 40 watts; when shades are omitted, 25-watt round lamps. Large dome shade, 150-watt lamp or if two sockets or more, 60-watt lamps. Semi-indirect unit, 200-watt lamp; two or more sockets, 60-watt lamps.

Kitchen: Ceiling glass fixture in centre for general illumination—150-watt lamp. Local light over sink, table or range—60-watt lamp.

Bathroom: In ceiling fixture for general illumination—60-watt lamp. In bracket lights at each side of mirror—40-watt lamps. In bracket light over mirror—60-watt lamp.

Bedrooms: In centre ceiling fixture of several sockets—40-watt lamps. In single bowl unit for general illumination—100-watt lamp. In dresser lamps—40-watt lamps. In wall fixtures over beds—40-watt lamps.



# Adequate Store Lighting Aid in Advertising

**By G. W. Austen**

THE proper lighting of retail store windows and interiors is of great importance to the merchant. Inasmuch as 87 per cent. of sales are made by seeing, plenty of light, arranged to make eye-ease for the customer, is a first essential at all times in operating a store successfully. The most successful stores pay a great deal of attention to their lighting—this is one good reason why they are successful! At least 75 per cent. of all retailers, however, fail to understand or appreciate properly what constitutes good lighting. Then they wonder what's the matter with business, and, as human nature is so prone to do, blame everyone else but themselves.

What consitutes good lighting? Broadly speaking, an intensity in the windows (from reflectors properly mounted and concealed from view from the street) of from 100 to 200 footcandles. This unit of lighting intensity is indicated by a special meter. In the interior the lighting intensity should be from 20 to 40 footcandles, derived from units spaced not more than 10 feet apart, on the average. A qualified electrical contractor or lighting specialist will soon lay out a good job.

It is not difficult to get relatively good and efficient lighting, when the merchant wants it, and is willing to listen to the wise counsel of those who really know lighting as it should be. The main trouble is that the average retailer doesn't appear to want to know. He evidently prefers to think that as long as he has some lights in his window, and some more units in the interior, giving a fair quantity of light, everything is all right!

The average retail merchant doesn't know whether he has enough lighting intensity for his type of store or not. He doesn't know whether his lighting is showing off his goods to best advantage or not. Frequently he doesn't know anything about "glare"—and how it prevents customers from seeing clearly. Some retailers have old-style reflectors and units that are utterly inefficient. Most retailers turn on their lighting when it gets dark, but they know almost nothing about the value of artificial lighting in the daytime. In fact, the category of lighting crimes in the retail selling field—where it is most important—is bordering on the encyclopedic.

Illustrating some phases of retail lighting problems, the Electric Service League of Toronto has been making some investigations in the Toronto retail field. The League has carried on propaganda work for years, trying to make retailers realize the advantages of well-arranged lighting, and has succeeded in convincing many of the need of improvement. But apart from the matter of the technique of good installations is the issue of WHEN to light. Out of about 9,000 retail stores in Toronto, only about 800 to 1,000 keep their window lights going in the daytime. The few understand—the many don't—that it is a

fact that by keeping window lights going in the daytime, on bright days as well as dark, an average of eight times as much light is thrown on the merchandise in the back of a show-window.

### Reflections Kill Value

Then there is the matter of the effect of bright sunlight on seeing window displays. Bright sunlight in the street casts reflections of street traffic, poles, buildings, etc., on the window and kills the display inside—unless the window lights are "on". Moreover, window glass reduces by nearly 50 per cent. the quantity of light filtering through from outside.

No matter what the weather conditions are outside, window displays are "dead" unless they have ample lighting from the reflectors. Displays that are set well back from the glass suffer particularly unless the lights are on. Some of the chain drug and grocery stores have shallow windows piled up with merchandise with price tags, to get benefit of what daylight there is—but these same chain stores have the best window and interior illumination in practically the whole retail field.

The Electric Service League has made many tests of the night traffic on principal shopping streets. It found that as many as 25,000 people passed along Danforth Avenue in a week, between 7 and 10 p.m. On north Yonge Street, Toronto, the number averaged 15,000 at night. In other districts 10,000. This raises the important question: Do you know how many people walk by the front of your store on the average week, by day and night? Do you know what percentage stop to look in your windows, or come into the store? Do you know how the "pulling power" of your store on the passing crowds compares with that of other neighboring stores, or with the average for your type of store?

Before chain store locations are decided, information as to traffic is compiled. The chain store executives know that out of 1,000 people passing, they can count on a certain percentage being attracted, and coming in. The ordinary retailer cannot afford to ignore the opportunity of getting transient trade. In most cases, new customers result from transient trade.

*Upstream View of Trethewey Falls Development.*

# Some Factors Conducive to Proper Lighting

By Eleanor Potts, Home Lighting Specialist, Toronto.

PROPER lighting is the balanced combination of quantity, quality, and distribution of light, which are dependent on three factors, the lamp base, the lamp shade, and the bulb, The fundamental purpose of a lamp is for better light and better light involves better sight.

Stock taking is never amiss in any efficiently managed organization; why not take stock of the lighting in your home—your living-room for example.

1. Is there enough light to make reading possible with the book or newspaper at least fourteen inches from your eyes? The light may vary according to your needs, from 25 to 100 footcandles. The only certain proof is a sight meter reading. However, we can suggest this check to assure at least the minimum amount of light—one socket table lamp, 100-watt bulb; one socket bridge lamp, 75 or 100-watt bulb; two-socket portable, 60-watt bulbs; three-socket portable, 40-watt bulbs.

2. Perhaps, after making this change, you find there is a sharp contrast between these lamps and the background of the room. By actual test we know you do not have too much light, but your eyes are complaining. Every time your eyes glance from the well-lighted book off into the darkened parts of the room they must adjust themselves. When this is frequently repeated the eyes become fatigued and strained. To relieve the possibility of such fatigue there should be an even intensity of light throughout the entire room. Light which is directed toward the ceiling and is then reflected into the room gives an even distribution of light. The metal and glass bowl reflector lamps, with or without the candle arrangement below, and the open top shades on other lamps serve very nicely. Wall brackets and ceiling fixtures, using inside frosted bulbs with shades, also aid in accomplishing this same result—indirect lighting.

3. Shade all light sources so that there is never any need for your guests or family being annoyed or made uncomfortable by lamp bulbs "striking them in the eyes."

4. In addition to general illumination sufficient light should be provided at any place in the room where members of the family might gather to write, read or sew. The chesterfield is easily lighted by twin lamps at either end; a combination of table lamp at one end and a bridge or lounge lamp at the other, or a floor lamp in the back. The Windsor or spinet desk is best lighted with a floor lamp at the left side. Watch carefully that the floor lamps beside the chairs are placed so that the occupants of the chair should never look into the unshaded bulb. A little to the back at one side, thirty inches from the bulb to the printed page is a good guide.

One can scarcely guard too carefully in the selection of a lamp shade to be certain that the one selected will give

the best results. Decoratively speaking the colour and style must blend harmoniously with the style and colour of the base and other furnishings in the room, but will this same shade lend itself to utility as well as beauty?

1. Is the lining of the shade white or light eggshell? Or are you losing light by having it absorbed in coloured linings?

2. Is the lower diameter large enough to allow an ample spread of light?

3. Is the top open to allow some light to escape to the ceiling?

4. Is the depth of the shade sufficient to cover the bulbs?

As you acquire new portable lamps and perhaps discard old ones, keep these few things in mind. Your eyes will be comfortable by an insurance against eye strain provided by correct lighting.

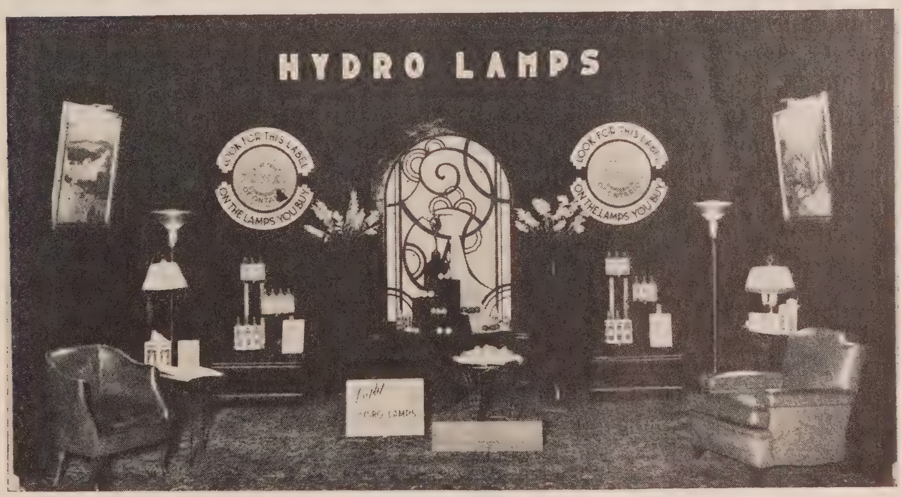
Do you read in bed? Select your lamp carefully, making sure that it throws the light on the book not directly into your eyes.

When sewing be certain that you select the best reading lamp available, as sewing is one of the most severe visual tasks in the home—guard your eyes accordingly.

Ample light in the laundry and kitchen helps to make sure the clothes are clean and avoids scorching while ironing.

Have you seen a way to improve your lighting for the bridge game?

Has this stock taking shown your present lighting "out of the red?" Guard against past experience—make your lighting do the job for which it was intended—to make seeing easier.



# Electricity in Rural Society

By Emily A. Pratt, M.D., State Education Dept., Albany, N.Y.

*(One of a Series of talks on "Some Practical Applications of Electricity in Farming", prepared under the auspices of the Rural Electrification Section of the General Electric Company, and Broadcast on October 26, 1934.)*

MAN was born a creature of of the outdoors and his day extended only from dawn to dusk. As civilization advanced, lighting methods advanced slowly with it. But it was not until Edison discovered how to produce light electrically within a bottle that the world made any marked progress with it.

To-day electricity is within the reach of nearly everyone. The barns are being lighted with it. Why? So that the farmer can see better. When he finishes his chores in the barn he is tired. After the evening meal he usually reads the paper. He reads the headlines with eagerness and ease, but before he goes far into the finer print he becomes sleepy. He thinks the reason for this fatigue is the strenuous labour of the day. The electricity that serves him in his barn, serves his house as well. But in a different way in the matter of lighting; he has little, if any, reading or close work to do in the barn. A ceiling light in the hay mow might do very nicely, but it will never do for the house, and yet in the house the fixture is usually in the middle of the ceiling and originally it was without a shade. It may be yet if his wife or daughter has not decorated it with a silk or paper one. The farmer who after reading the paper a short while becomes tired, and goes off to bed, may think he needs glasses and perhaps he does; glasses may help matters, but I venture to say that better light for seeing will help far more. I have said nothing about the children reading or studying their lessons lying prone on the floor. The light from the ceiling, bridge lamp or three bulb fixture or even all three does not reach them in a sufficient amount to keep them from having eyestrain which the school nurse, doctor or teacher discovers.

Let us look to our eyes for a moment. They were made for distant seeing, for outdoor work such as caring for the sheep and cattle. Food originally was obtained by hunting. There were no newspapers then. Later man commenced to secure his food by labour—industry. Pottery was made, weaving was done and the products exchanged for food and shelter. The farmers may say "That is what we are doing now". Yes, it is but in addition he is reading at the near point and doing that reading under artificial light and not natural light. When we are young we read easily at the near point because our eyes are farsighted when we are born. Gradually we become nearsighted. Girls and boys have no difficulty making the adjustment from play to work to reading or sewing because their eyes can make the change very easily. Older people cannot make this adjustment easily. If we attempt to read fine print under insufficient light, we strain our eyes and in

straining our eyes our bodies become fatigued so that we give up our evening tasks; or may we say pleasure.

What concerns us with our seeing consists of three factors. Two of them we have little or no control over. The third is the one variable which we can turn to if we want to make our seeing task easier; if we want to help preserve our most precious possession—our eyesight. These three factors are: 1. The visual task. Usually we must accept our tasks as they are. If we are typing in an office we must continue to type, for our bread and butter depends upon it. The same principle holds true with reading at night for in order to keep up with others in our community we must read. We can however refuse to permit our children to read very fine type or perform abnormally difficult visual tasks. We can refuse to be satisfied with the unnecessarily poor conditions for seeing when difficult tasks are involved. The second factor is the eye. A wonderfully exact science has been developed for correcting eye defects with glasses. For defective eyes there are no substitutes for the service of the eyesight specialist. The third factor is lighting. This factor we can control. Better lighting is the best possible way to improve seeing and is applicable to all classes of eyes and all visual tasks.

The eye is a marvelous organ. Not so remarkable that it is able to adapt itself in the short space of a few seconds to the average change we have imposed upon it. Perhaps that is why so much eye trouble is prevalent to-day. We find damaged eyesight in 15 per cent. of the school children, 40 per cent. of the college population and 60 per cent. in those forty years of age and 95 per cent. in those 60 years or over. Out of doors in the bright sunlight there are ten thousand units of light, in the shade one thousand, on the porch five hundred, by the window in the daylight, two hundred units of light and back in the office by the wall during the daytime or in the living room or kitchen we find four and even less units of light. In order to see adequately for fine print we should have at least twenty units of light.

Conservation of vision is most important to all of us. We must therefore look about us and see wherein we can protect our eyesight that we may conserve the good vision with which we were born. May I suggest that if we have the slightest suspicion that our lighting is inadequate, do not penalize our eyesight. Our local power and light companies have specialists who can assist us. They are not selling fixtures. What they can do is to advise us as to the best kind of light and lamps to secure for a minimum consumption of electricity but best of all for the preservation of our eyes, that we may conserve the sight not only of ourselves but of the future generations.

# Light for Sight, Plant Growth, and Beauty

By Lawrence C. Porter, Illuminating Engineer, Incandescent Lamp Dept., General Electric Company, Nela Park, Cleveland, Ohio.

LIGHT for sight is an all sufficient reason for good illumination. Yet when decorative accomplishments can be added to the utilitarian purpose, a double benefit is obtained. And when this combination is utilized in connection with Nature in such a way as to promote plant growth, the efficiency of the lighting is three fold.

During the past few years many studies and tests have been made of the effects which light has on plant life. The research has included artificial light of various colours, of different intensities, and of different durations of exposure when used alone and as a supplement to daylight.

From investigations made at the Boyce-Thompson Institute for Plant Research in Yonkers (N.Y.), the U.S. Department of Agriculture in Washington (D.C.), and at many of our leading universities, it has been found that the time of bloom and rate of growth of most plants are primarily controlled by the number of hours of light in each twenty-four. The short hour plants are those that bloom in early spring and late fall. The long-hour plants bloom naturally in summer. Many of the summer plants can be made to bloom in the spring by using artificial light to extend the daylight hours in winter so that the total lighted period per day corresponds to the number of mid-summer hours of daylight. Conversely, extending the lighting period for some of the short-hour plants will retard or or even prevent bloom. Summer-blooming plants may be had in the middle of winter and winter-blooming plants in summer by proper control of the lighted period and of the heat and humidity. Supplementing daylight with artificial light not only speeds up plant growth but in many instances produces more and larger blossoms and plants.

Commercial plant growers are beginning to make productive use of artificial light in their greenhouses Such an application is shown in Fig. 1. The plants on the right, under daylight supplemented with a few hours of artificial light, were brought into bloom sooner than those on the left, which received daylight only. A test at Purdue University showed that pansies receiving as little as one and one-half footcandles of artificial supplementary light averaged 13.3 blossoms per plant as against 1.8 for those receiving daylight only. The number of blooms of aster plants was increased in the same manner by 86 per cent., and the average diameter of the blooms was increased from 2.2 in. to 3.3 in. Tests made at Ohio State University on some 25 different kinds of flowers, commonly grown in greenhouses, yielded the results given in Table 1.

Experience has shown that in most cases special lamps are not necessary. Plain, ordinary tungsten lamps of the types commonly used in the home produce entirely satisfactory results when arranged to give a lighting

*Fig. 1—A comparison of the Greenhouse Stock Plants left and right, showing the advantage of using artificial light commercially to promote plant growth.*

intensity of eight to ten footcandles for five hours per night, either immediately following dusk or just preceding dawn.

For commercial applications, suitable porcelain enamel reflectors may be used; and when the mounting height of the units is approximately two-thirds their spacing, the footcandle intensity on the plants for different wattage lamps will be approximately as shown in Table II.

Doubtless the day will come when many of the more valuable plants will be grown in windowless greenhouses made of heat-insulating material. In such a house advantage will be taken of the ever-increasing efficiency of light sources. Sodium lamps now operate at some 60 lumens per watt,

TABLE I

| Decrease in Number of Days to Bloom | | Increase in Number of Flowers Per Plant | Cost per Sq. Ft. of Bed Area (cents) | Cost Per Flower (cents) |
|---|---|---|---|---|
| Maximum | 67 | 44 | 16.4 | 3.6 |
| Minimum | 4 | 0 | 2.9 | 0.006 |
| Average | 30 | 12 | 7.5 | 0.5 |

TABLE II

| Spacing (feet) | FOOTCANDLES | | | |
|---|---|---|---|---|
| | 25-watt Lamp | 40-watt Lamp | 60-watt Lamp | 100-watt Lamp |
| 4 | 20 | 35 | .. | .. |
| 6 | 9 | 15 | 26 | 50 |
| 8 | 5 | 9 | 14 | 28 |
| 10 | 3 | 5 | 9 | 18 |

or approximately three times the efficiency of comparable tungsten-filament lamps. The cost of electricity is steadily decreasing. The heat of the lamps will be used to heat the greenhouse in winter. Humidity as well as light and heat will be automatically controlled. Perhaps carbon dioxide will be fed to the plants from commercial tanks. Under such conditions parasites and plant diseases can be greatly reduced if not entirely eliminated. In the greenhouses of the future it should be possible not only to predict but to regulate almost to a day the blossoming date of any plant

—*General Electric Review*

# A. M. E. U. CONVENTION

## *at* ROYAL YORK HOTEL, TORONTO

JANUARY 29 and 30, 1935

# New Developments in the Art of Street Lighting

THE developement of the sodium-vapor lamp described in the report of the ASME Committee on Street and Traffic Lighting last year and the equipment required for its use in the field of street lighting has now advanced to the point in this country where considerable public and official interest has been aroused in its possibilities and application. European practice in the use of gaseous-conductor lamps is somewhat in advance of that of the United States and many interesting installations may be observed throughout the continent.

Manufacturers report that a fairly large number of trial installations have been put on demonstration in various parts of this country and others have been put into actual street lighting service. While it is true that this light source is new within the past two or three years and of course subject to future development, particularly in its lumen output efficiency and service life as laboratory research progresses, in its present form it seems to be functioning very well.

### Is Especially Applicable to Highway Lighting

From the observations and studies that have been afforded by the installations now in service in the field of street lighting practice, the sodium-vapor lamp seems especially applicable to highway illumination, where the effects produced by the monochromatic orange-yellow color of the light source appears to be of much less importance than on urban streets.

Present demonstrations of the sodium-vapor unit, particularly in the eastern states, are largely on interurban and rural highways. This lamp is now being made in 4,000, 6,000 and 10,000 lumen sizes. Fixture equipment has been especially designed to conform to highway lighting requirements.

### Mercury-Vapor Lamp for Street Lighting

During the past year another gaseous-conductor light source, designed for street lighting service, has been placed on public demonstration. This is the high pressure mercury-vapor lamp. The general principles of design and operation are quite similar to the sodium-vapor lamp, except in the color of the light produced. In contrast to the monochromatic golden-yellow color of the sodium-vapor lamp, the mercury-vapor lamp emits a light which has predominately a blue-green color, with a complete absence of all wave lengths in the red bands of the spectrum. It is possible to correct this deficiency in the mercury-vapor light through a combination with the light from a tungsten filament incandescent lamp and obtain a whiter light than that now furnished by present street lighting lamps.

Mercury-vapor lamps heretofore employed in the field of industrial lighting have operated at relatively low gaseous pressures generating their

light output at 10 to 12 lumens per watt of electric energy consumed. Through research and experiment, it was found that by operating the gas at considerably higher pressures, approximately that of one atmosphere, much higher luminous efficiency could be attained. The new high intensity mercury lamp designed for street lighting use is operated at this higher pressure.

This lamp is made up in tubular bulb form and employs a screw socket like the ordinary filament lamp. The bulb actually consists of two tubes, one within the other, the space between the two being evacuated in order to minimize heat losses. At each end of the inner bulb, a double electrode is provided, the arc being established between the two pairs of electrodes. When first turned on, the lamp glows for a few seconds with a ghostly glow afforded by argon gas which first establishes the arc. Then, after a few seconds, as the liquid mercury begins to vaporize, the characteristic blue-green glow of mercury, but of rather low intensity, is shown. Then, over a period of approximately 10 minutes, the lamp grows brighter as more and more mercury is vaporized and serves to establish a stronger, more intense arc. When the lamp stabilizes at operating conditions after 10 minutes to 15 minutes of service, the light is chiefly emitted by an arc stream of incandescent mercury gas at the centre of the bulb.

What the future possibilities may be for the gaseous-conductor light sources in the art of street lighting can not be foretold at this time because these lamps, the equipment required for their use, and their field of application are still in the stages of development and demonstration. However, at this time, it is believed that the sodium-vapor lamp is particularly useful in highway lighting and the mercury-vapor lamp to "White Way" lighting on business streets perhaps in combination luminaries employing both mercury-vapor and incandescent lamps.

The principal advantage claimed for the gaseous-conductor lamp over the tungsten filament incandescent lamp, is the much higher luminous efficiency per unit of energy consumed. At present, due to the limited production of lamps, equipment and lack of operating experience, costs are high and offset savings in power consumption. With quantity production, cost of both lamps and equipment will be materially reduced and the use of gaseous-vapor lamps for street lighting, where this light source is particularly adaptable, will undoubtedly increase.

### New Multiple and Series Street Lighting Lamps

During the past year the incandescent lamp manufacturers have announced a new line of multiple lamps specially designed for street lighting service. The most significant change in these lamps is that their average rated life is 1,500 hours in comparison with the average rated life of 1,000 hours* for the general service multiple lamps.

A new line of series street lighting lamps, known as the "group replacement" line has also been announced

* Hydro lamps have had 1,500 hour rating for some years.—*Bulletin Editor.*

by lamp manufacturers. The smaller lamps in this line have a longer rated life, thereby giving in effect a greater "factor of safety" against burnout of these lamps between group replacements. This greater "factor of safety" against burnout is desirable because the smaller lamps are for the most part in the outlying districts where patrolling is less frequent and where the cost of emergency replacements is higher.

The foregoing is an abstract of a report of the Committee on Street and Traffic Lighting of the American Society of Municipal Engineers presented at the Congress of the Society, held September 24 to 28 at Rochester, N.Y.—*Roads and Streets.*

# Electricity on the Poultry Farm

THERE are more poultry farmers using electricity today than any other class of farmers. In some parts of the country, more especially in Lancashire, electrically lighted poultry houses on the hillside make a very impressive picture at night. The number using electric light for improving the winter egg production is rapidly increasing, as the practice is now recognised as a sound commercial undertaking. Other well-established electrical uses on the poultry farm include electric incubators, brooders, egg testers, plucking machines, and so on.

Only a few days ago the writer was discussing electric brooding with a poultry farmer who, though quite convinced that the electrical method was ideal, as it gave uniform heat without fumes, regular temperature and required no attention, still felt that the cost of rearing chicks in this way was excessive. As actual results are the only convincing means of showing that the electric way is anything but expensive in direct costs, without making allowance for the many indirect savings which result when electricity is used, the writer drew the poultry farmer's attention to the results obtained last spring by Mr. E. C. Rees, of Church Farm, Besford, who reared 2,000 chicks in an electrically heated outdoor foster mother. The heat was kept on the chicks until they were one month old. They were then placed out on range, though a small amount of heat was provided for about a week. The birds were very hardy and feathered up tightly, and numerous poultry experts who saw them were impressed by their hardiness and alertness. Mr. Rees, on 18th April, of this year, wrote to the Shropshire, Worcestershire and Staffordshire Electric Power Co., who were supplying him with electricity, informing them that the chicks reared in the electric foster mother had done remarkably well. The birds were very healthy, with bright shiny eyes, "for which I think," said Mr. Rees, "heating by electricity is responsible in preference to other forms of heating."

Mr. Rees was also very anxious to determine whether electric heating, in spite of its outstanding advantages, was really as cheap a source of heat as others available. He kept accurate figures of the cost. He was paying

1¼d. per unit for electricity and he found that the cost of electric heating up to one month old was ½d. per chick, which means that the consumption of electricity amounted to less than half a unit per chick to one month old. This unbiased statement was sufficient to convince the poultry farmer referred to that electricity, rather than being an expensive luxury, was one of the most valuable aids in assisting him to produce better stock at a lower cost.

Quite a number of poultry farmers who have installed some of the more generally known electrical appliances are now looking round for other ways of using this very accommodating source of power. Among the less-known uses are the following:—

CHICKEN SCALDERS — Electrically heated chicken scalders are not unknown. Those that have come to the attention of the author consist of a metal tank, heated by means of a thermostatically controlled electric heater. One design of scalder is divided into two compartments and has a false bottom to catch the feathers. Each compartment is heated by a thermostatically controlled, 750-watt heater. One compartment is larger than the other, the temperature of the larger being 140 deg. Fahrenheit and that of the smaller 190 deg. Fahrenheit. The size of the scalder is 39 in. long by 24 in. wide by 19 in. deep. Quite apart from the obvious advantage of having such a scalder available, the availability of a constant supply of hot water is extremely useful.

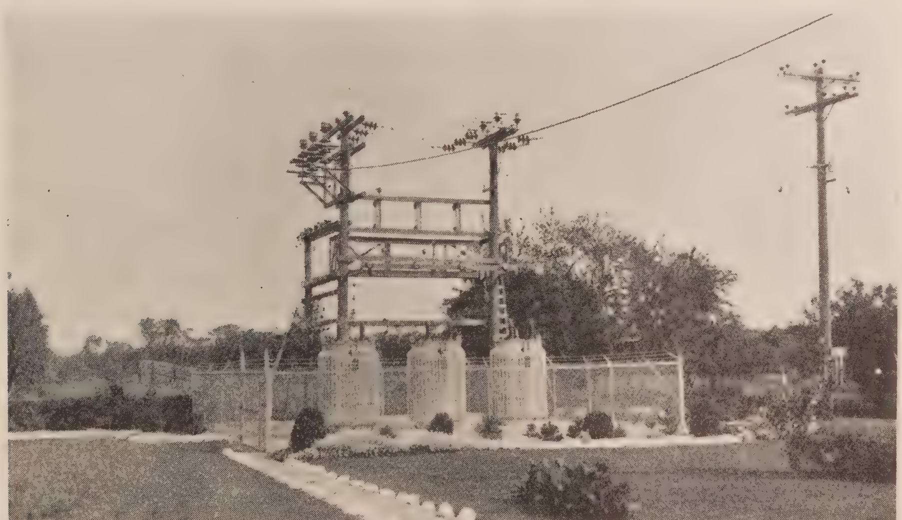
AUTOMATIC CLEANING DROPPING BOARDS—In order to eliminate the labour required for cleaning poultry houses and dropping boards, some poultry farmers have installed flexible dropping boards which are operated by means of a small electric motor. The installation takes much the same form as an endless canvas belt on a grain binder. A stationary scraper is fitted, either just inside or outside the house, below the end of the moving platform and bearing against it so that the droppings are caught in a container and from there carried away. In one installation a cart is placed at the point of discharge, when the band is operated so that all the droppings fall into the cart, thus eliminating all hand labour up to the point of unloading the cart. A ¼ h.p. motor is ample size for this class of installation.

OAT SPROUTERS—Sprouted oats are a valuable stand-by for the poultry farmer during the winter months. One home-made sprouter which provided sufficient green food for about 300 hens, was heated with a 25-watt heater. Sprouters usually take the form of six or seven tier trays with an outer casing, round which is placed a heating element. Tests carried out some time ago showed that a 125-watt heating element would provide sufficient sprouted oats for over 1,000 chickens.

WATER HEATERS—Hens drink far more freely when the chill has been taken off the drinking water during the winter months. This is conducive to a higher egg production. The ordinary type of electric water heater can be used for 60 hours with the consumption of one unit of electricity; the cost is, therefore, infinitesimal. Further, there is no need to leave the water heater on except during very cold weather.

EGG CLEANERS—A machine which cleans eggs properly without immersion in water, is a valuable ally to the poultryman who caters for the best class of egg trade. There are now electrically operated egg cleaners of this type which not only wash up to 3,000 eggs per hour, but also dry the eggs so that they can be packed immediately. In one machine of this type, the main body is divided into two sections, one which contains water for cleaning and the second forms a guard and bearing for the brushes. Three long tufted brushes run longitudinally through the whole length of the body, the first half of the brushes being designed for washing and the second half for drying. The eggs are fed into the brushes through an aperture at one end of the machine and travel through the brushes, automatically emerging at the other end, on to a wire tray. An electric immersion heater is fitted into the water chamber in order that the water may be maintained at a suitable working temperature. The size of the motor for driving the brushes is 1/6 h.p., i.e., it takes very little more current to drive the motor than is required for lighting a 100-watt lamp.

EGG GRADERS—These are equally important on large egg-producing farms which cater for the best class of trade. A grading machine introduced this year consists of six scales, which are mounted on an aluminum table. The table is caused to revolve by a small electric motor. As the scales rotate, small weights on pivoted arms are automatically released as the scales pass each grading section and when a balance is obtained, the egg passes into one of the five grading segmental trays. This type of machine will deal with eggs at the rate of about 3,000 per hour. It is driven by a small 1/8 h.p. electric motor. The makers guarantee the machine to weigh within 1/24 of an ounce.—*Rural Electrification and Electro-Farming.*



*Sub-station in Sutton for Keswick Rural Power District and Sutton.*

## Trends in Engineering Research.

The greater part of engineering research has been carried on in the past in commercial organizations. While some such dignify with the name of research even crude empirical control of materials or processes, there are at the other extreme concerns which carry on scientific and engineering research of a high order. The commercial organization has, by its very nature, a point of view which is likely to be restricted. In the narrow sense it is responsible to its stockholders for a profit, and this leads to a restriction of its research to the immediately profitable. In a larger sense it is responsible to its employees for security against the fluctuations of employment consequent upon shortsightedness, and it is responsible to the public for the best possible ultimate development of the products or services it supplies. A recognition of this broader responsibility carries with it an appreciation of the value of research on a more comprehensive and far sighted basis. That the more mature and socially sound point of view has appeared at all in our capitalistic scheme is a reassuring fact which is worthy of greater emphasis that it receives. Wherever this advanced philosophy guides the management, will be found research laboratories in a highly developed state of advancement, for the interests of all in the proper progress of an industry can be safeguarded in no other way.—*From an address by Vannevar Bush.*

—*Bell Laboratories Record*

## The "Electric Fluid" of 1843.

After seeing the close approximation to daylight of 1934 lighting media, it is more than interesting to run across the following, which appeared in a British journal of 91 years back, and passed to us by J. B. H. Benard of the Communications Department of the Canadian Pacific Communications System, Montreal.

"A letter from Paris dated October 21, 1843, gives the following interesting account of the first public trial of an experiment which had been more than four years in preparation, for fixing at a given point the electric fluid, and making it applicable to the purpose of lighting the streets and private houses.

"On one of the bases of the statues called the Pavillion de Lille, on the Place de la Concorde, a glass globe of apparently 12 or 13 inches in diameter, with a movable reflector, was fixed in connection with a voltaic battery, and at a little before nine o'clock the electric fluid was thrown into it by a conductor. At this time all the gaslights of the place, about 100 in number, were burning. As soon as the electric light appeared the nearest gaslights had the same dull, thick and heavy appearance as oil lamps have by the side of gas; soon afterward the gas lights were extinguished and the electric light shone forth in all its brilliancy. Within 100 yards of the light it was easy to read the smallest print; it was, in fact, as light as day. The astonishment of the assembled multitude was very great, and their delight as strong as their astonishment.

"The estimate made by the scientific persons who were present was

that the electric light was equal to 20 of the gas lamps, and, consequently, that five of those lights would suffice to light the whole place most brilliantly. As regards the expense of production, nothing positive has transpired, but I think I may safely assume that it would be considerably less than that of the generation of gas, while the first outlay for machinery and conductors would not amount to a twentieth part of that required for gas works.

"There would also be another great advantage in the electric light. It gives out no bad smell; it emits none of those elements which, in the burning of gas, are so injurious to health, and explosion would be impossible. The only danger that would arise would be at the battery itself, but that would be at the control of competent persons; and even in this respect there would be no danger, even to unskilled persons, with an apparatus of moderate size. Internal lighting would be as practicable as external lighting, for by conductors the fluid would be conducted to every part of the house.

"The experiment performed last night was with a voltaic battery of 200 pairs composed as follows: First, an outer globe of glass; secondly, in this globe a cylinder of charcoal, open at both ends, and plunged in the nitric acid contained in the outer globe; thirdly, in the cylinder of amalgam of zinc plunged in acidulated water (with sulphuric acid). This replaced the cloth in the common battery; fourthly, in the porcelain vase cylinder of amalgam of zinc plunged in acidulated water.

"The pile was on the Pavillion de Lille; the two copper conductors from the two poles are pointed with charcoal and lead to an empty globe from which the air has been exhausted. The two fluids, on meeting, produce a soft but intense light.

"I understand that the experiment was considered highly successful by the authorities who were present and it is to be repeated on a large scale. Should the thing work as well in a general way as it did last night, and the cost be less than that of gas, which it must be, there will be a tremendous revolution in gas works. I have heard it asserted by persons who are acquainted with Mr. Achereau, the gentleman who performed the experiment last night, that a company for the supply of the electric light would realize a handsome profit on charging only a sixth of what is now paid for gas. The strength of the electric light did not appear to me to exceed that of the hydro-oxygen; but it is much more simple in the apparatus required, and much less costly in the expense of production. The hydro-oxygen light requires a double and most expensive apparatus, and it is only applicable to a few localities; the electric light may be applied externally and internally in any place."

—*Electrical Digest.*

# Association of Municipal Electrical Utilities

## Minutes of Executive Committee Meeting.

A meeting of the Executive Committee of the Association of Municipal Electrical Utilities was held at the Toronto Hydro-Electric Club House on the afternoon of Wednesday, October 24th, 1934. Those present were Messrs. W. R. Catton, Chairman; O. M. Perry, E. V. Buchanan, D. B. McColl, O. H. Scott, P. B. Yates, C. A. Walters and S. R. A. Clement.

The Minutes of the Executive Committee meeting of September 5th, 1934, were read and approved.

A letter from Mr. F. A. Gaby, former Chief Engineer, Hydro-Electric Power Commission of Ontario, dated July 11, 1934, was read. This letter referred to the duties of the Electrical Inspection Department and the Approvals Laboratory in enforcing the regulations respecting electrical installations and equipment and suggested the utilities include notices on the reverse side of their bills, calling the consumers' attention to the regulations regarding the use of approved wiring and appliances. Discussion showed that this was being done by a number of the Utilities, and it was moved by Mr. E. V. Buchanan, and Seconded by Mr. O. M. Perry "THAT the letter be filed."—*Carried.*

A letter from the Royal York Hotel, Toronto, advised that the dates of January 29th and 30th, 1935, had been made available for the winter convention of this Association.

Mr. O. M. Perry, Chairman, Convention Committee, presented a report from that committee regarding convention entertainment. It was proposed that this Association have its own badges for the convention and that should the Ontario Municipal Electric Association decide to have its Annual Meeting at the same time, it be left to obtain separate badges for its members. Mr. B. K. Sandwell, Editor, *Toronto Saturday Night*, was suggested as speaker for the luncheon on Tuesday, January 29th. At the convention dinner there would be musical entertainment by a male singer in addition to an address by Mr. T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario. For the luncheon on Wednesday, January 30th, 1935, to which the Electric Club of Toronto is to be invited, the Committee is endeavouring to obtain a speaker from the General Electric Laboratories instead of asking the Electric Club to supply the speaker. The Committee asked for an appropriation of $200.00 to cover the cost of entertainment. Mr. Perry moved the adoption of his report which was seconded by Mr. O. H. Scott and *Carried.*

Mr. D. B. McColl presented a report suggesting a programme of papers and discussion for the convention and moved the adoption of his report. This was seconded by Mr. E. V. Buchanan, and carried as follows:—

Tuesday, January 29th—
Afternoon Session—
Reports of Committees

Papers on Load Building.

Wednesday, January 30th—

Morning Session—

Paper on Street and Road Lighting

Papers on General Lighting.

Afternoon Session—

Paper on the Possibility of Load Building by Use of Domestic Appliances.

Paper on Safety.

Paper on Expired Meter Records.

There will be an Accounting session in a separate room on Wednesday morning, January 30th.

Mr. D. B. McColl spoke of a meeting that had been held on the preceding day when Hydro Shops was discussed and a recommendation was desired from this Executive Committee regarding co-operation with Contractor-Dealers on merchandising appliances. Mr. O. H. Scott, Chairman Merchandising Committee was instructed to forward to the Chairman and each of the Commissioners of the Hydro-Electric Power Commission of Ontario, copies of the report "Principles and Facts, Public Utility Merchandising".

The meeting then adjourned.

* * * *

## Nominations for 1935 Officers.

The Scrutineers' report of the Primary Ballot showing nominations for officers of the Association of Municipal Electrical Utilities for 1935 gives names as listed below, being in order of the number of votes received. According to the results the names marked with a star (*) are to appear on the Election Ballot, unless withdrawn by the nominees. The Election Ballots will be distributed at the Winter Convention on the morning of Tuesday, January 29, 1935, and the Ballot Box will be closed immediately after the opening of the afternoon session on that day. The nominations are as follows:—

President—O. M. Perry,* W. R. Catton,* T. W. Brackinreid.

Vice-President—D. B. McColl, R. S. Reynolds,* C. A. Walters,* W. H. Childs* (all three tied), P. B. Yates, O. H. Scott, R. S. King, V. S. McIntyre, H. G. Hall, C. J. Moors, E. V. Buchanan, O. M. Perry, R. J. Smith, H. F. Shearer, J. R. McLinden, W. E. Reesor, J. C. Johnston, J. E. Skidmore, V. A. McKillop, W. R. Catton, J. E. Teckoe, M. W. Rogers, Geo. Grosz, A. B. Manson.

Secretary—S. R. A. Clement,* D. J. McAuley.

Treasurer — D. J. McAuley,* H. T. Macdonald,* W. B. Munroe, E. V. Buchanan, R. P. Darrall, D. G. Ferguson.

Directors(*from the membership at large*)—O. H. Scott,* E. V. Buchanan,* D. B. McColl,* J. W. Peart,* P. B. Yates,* J. R. McLinden,* T. W. Brackinreid, C. E. Schwenger, J. E. Brown, J. E. B. Phelps, R. L. Dobbin, J. R. Smith, C. A. Walters, R. S. King, M. W. Rogers, T. R. C. Flint, G. E. Chase, W. R. Catton, A. W. Bradt, R. S. Reynolds, A. B. Manson, C. J. Moors, V. S. McIntyre, J. E. Teckoe, H. F. Shearer, W. H. Childs, O. C. Thal, J. E. Skidmore, C. E. Brown, R. Thompson, F. Barron, A. E. Willard, G. F. Shreve, E. R. Smithrim, R. O. Quick, C. C. Folger, F. L. Mason, V. A. McKillop, A. L. Farquharson, A. B. Scott, H. G. Hall, R.B.Hanna, W.B.Reynolds, H.P.L. Hillman, G. N. Gallaway, E. J. Staple-

ton, H. Campbell, Chas. Wilson, A. M. Bowman,

District Directors—

Niagara District—A. B. Manson,* J. E. Teckoe,* E. V. Buchanan, H. F. Shearer, W. H. Childs, R. S. Reynolds, V. S. McIntyre, J. E. B. Phelps, C. E. Schwenger, D. B. McColl, J. W. Peart, P. B. Yates, R. Thompson, H. G. Hall, O. C. Thal, J. Kirby and J. G. Archibald.

Georgian Bay District—C. E. Brown,* J. R. McLinden, J. F. Linn*.

Central District—G. E. Chase,* C. C. Folger,* J. E. Skidmore, R. O. Quick, C. A. Walters, G. F. Shreve, W. E. Reesor, F. L. Mason.

Eastern District—A. L. Farquharson,* M. W. Rogers,* T. E. Foster.

Northern District—T. W. Brackinreid.*

## The Growth of Safety Methods.

Good traditions and inspiring superstitions live on forever; those that are sordid and unwholesome die out.

Consider the old sacrificial custom among builders, for instance as late as the 17th century and in no less an enlightened country than England, it was customary to make a human sacrifice and bury the body under the cornerstone of a newly built structure. This, it was believed, would insure stability. It seemed all right to the builders of those days. They knew no better. The cruel custom died out, but when an advancing civilization and a changing social structure called for the construction of huge cities and towering skyscrapers of stone and steel, the ugly superstition was replaced by a reality that seems almost as inhuman.

Not so long ago it was generally understood that the construction of a high building would cost a life for every floor. Twenty stories—twenty lives! Some would fall from scaffolds. Others would get hit by falling objects. Infection, too, found a rich field here for its deadly ravages. Strange to say, men accepted this estimate as a normal expectancy. They knew no better.

Now that cruel era is gone. Great skyscrapers are often built now without the loss of a single life. It has all been simple. To-day in most construction work every possible safety contrivance is provided and men obey strict safety rules. It has not been so much a mechanical problem as a changing state of mind, a growing consciousness of the value of human life.

The old sacrificial custom was banished when intellect finally decreed that it was barbarous. The sacrificial reality of later years was banished when we came to realize its cruel and needless waste.

Yes, our wholesome traditions will live forever. And inversely, there will come a time when every foul and ugly superstition will be recorded only in history.—*Winnipeg Hydro News.*

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


## Load Building Through the "Better Light—Better Sight" Campaign

**By L. Treuge, Windsor Hydro-Electric System**

THE nation-wide Campaign for Better Light and Better Sight in our homes, schools, offices and factories, has reopened a neglected field for electric utility load expansion. Originally the electric utility was formed to supply light, but with the development of the heating and motive powers of electric current, heavier loads were able to be sold, and the energies of the utilities were bent to the encouragement of the use of these loads. For fifteen or twenty years, lighting has not been viewed in its true importance as a load building factor. The "Better Light—Better Sight" campaign may be regarded as a renaissance, to the utilities as a load builder—to the consumers as an agent for increasing their material comfort. To-day, with the field for new consumers drastically limited, we must bend our resources to increasing the loads of our existing consumers. We have here in Ontario over 660,000 consumers, all of whom are prospects for an increased consumption of electrical energy, through an increase in lighting. Much of favourable public opinion has already been created by the extensive advertising of the major lamp manufacturers. It remains for the Hydro-Electric Systems to capitalize on this, by the application of the energies and talents of our organization, to the individual consumer.

To this end, the Windsor Hydro-Electric Commission has deemed it advisable to inaugurate an intensive campaign for "Better Light—Better Sight".

On November 1, 1934, the campaign swung into action. Three avenues of approach were considered and adopted:—

1. Direct Advertising.
2. Employee Education.
3. Demonstration.

Direct advertising has taken the form of newspaper advertisements, bulletins on the backs of consumers' bills, and outdoor advertising by means of an illuminated bill-board in a downtown section of the city.

## CONTENTS

**Vol. XXI** **No. 12**

**DECEMBER, 1934**



The coverage will thus be seen to be fairly complete.

Our programme of employee education requires that every member of the staff, whose daily work brings him into contact with the public, attend two lectures a week. These lectures include, the nature of light sources, the process of seeing, comparative levels of natural and artificial lighting, and the physiological effects of inadequate lighting. Employees are trained to recommend the accepted levels of illumination for special tasks and occupations, and to advise arrangements and types of lighting for any application. They are further qualified to estimate in all cases the cost to the consumer in kw-hr. consumption of adequate lighting. Salesmen and contact men in the district are still further trained in the use of our special demonstration kit, and in demonstrations in the model living-room erected in our downtown office. We feel that as a result of this programme, we have a trained staff of approximately thirty employees, who are able to give


*Outside of demonstration booth erected in Windsor Hydro Shop.*

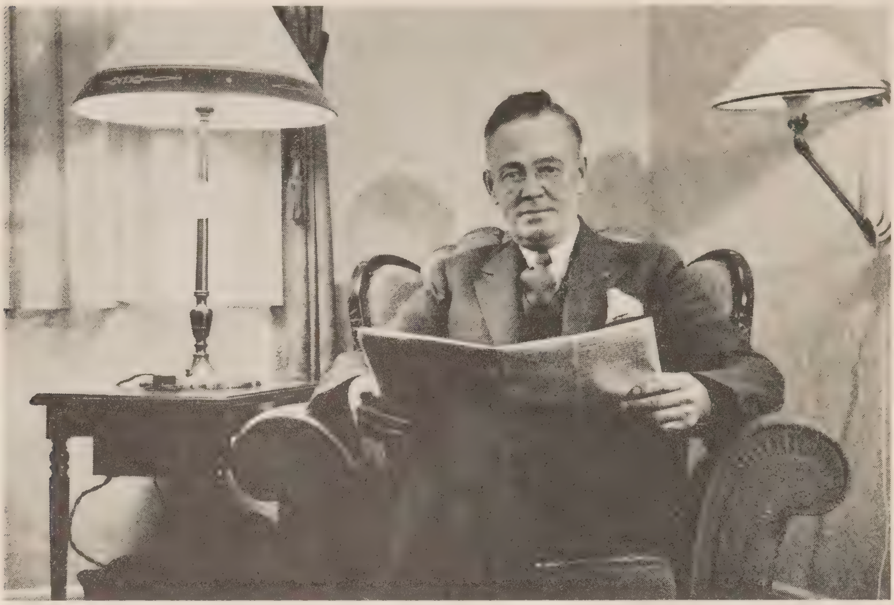
*Interior of "Better Light—Better Sight" booth.*

intelligent and competent advice on any of the questions which come as a natural result of the advertising programme.

Demonstration is, in the case of a "Better Light—Better Sight" campaign, the final and most conclusive selling point. We have in Windsor, two methods of demonstration—Home Demonstration and Model Living-Room Demonstration.

With a demonstration kit, a representative of the System is able to go into any home or place of business and show the benefits of adequate lighting. The kit consists of a sight meter, coloured and inside frosted white lamps, new and time-worn lamps, portable white linings for dark lamp shades, and samples of various wall and ceiling surfaces. By means of this equipment, our representative is able to duplicate a large number of existing conditions in home, commercial and industrial lighting, and show methods of correcting them, when they are not conducive to good lighting. This service is not forced upon the Public, and all calls to date have been made at the request of the consumer.

Our model living-room is erected on the floor of our Merchandising Dept. It is a booth constructed of wall board and furnished in the manner that might be found in the average home. The fixed lighting consists of a centre unit and two wall brackets. In line



*Method of demonstrating light intensities to a customer, the table at the left contains the rheostats for varying the lighting.*

with the modern trend, lighting is, of course, localized. General illumination is provided by the fixed units, and localized lighting for reading or sewing is left to portable units. Thus on either end of the chesterfield are placed junior lamps, and by each chair a table lamp. The units are of the I.E.S. type and as a result embody the best principles of modern lighting. One of the units in this room is equipped with rheostat control. The procedure is to allow the interested person to select the intensity of light most agreeable to him in the performance of three simple visual tasks. The sight meter is then introduced and the inevitable result is that foot-candle intensities are shown far above those to which the person has been accustomed. From this point, we have found that the individual is convinced. The last step in the model living-room demonstration is the recommendation of suitable units to produce the desired intensity for the interested person. This is, of course, followed up by a visit to the home.

It has been our experience that a lively interest has been displayed by the public at large in the subject of lighting. Local furniture dealers and decorators have made inquiries from our representatives and advice and recommendations are freely given. We feel that the campaign has taken definite root, and indications are for a substantial return for the efforts expended.

With the new science of the intimate relationship of light to sight now becoming more widely known to the general public, it is our duty, as public servants, to place our resources and

WINDSOR HYDRO-ELECTRIC SYSTEM

BETTER LIGHT - BETTER SIGHT - ANALYSIS

FOR— DATE— 193

AT— CALL BACK— 193

| PORTABLES OR FIXTURES | BULBS AS FOUND | RECOMMENDATIONS | | | BULBS INSTALLED |
|---|---|---|---|---|---|
| | | SHADES | BULBS | POSITION | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| TOTALS | | | | | |

NOTE: USE 115 VOLT INSIDE FROSTED MAZDA OR HYDRO LAMPS.
USE LIGHT COLORED LININGS IN PORTABLE LAMP SHADES.
USE SHADES OR GLASSWARE ON ALL BARE LAMPS.

LIVING ROOM AT—

AS FOUND

AS RECOMMENDED

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MONTHS | | | | | | | AVERAGE |
| K W HRS | | | | | | | |
| NET BILL | | | | | | | |
| AVERAGE COST PER DAY | | | | | | | |

DEMONSTRATION BY

*Form used to record "Better Light—Better Sight" analyses in homes. Left, front of sheet; right, reverse side.*

trained personnel at the disposal of the public in making better lighting within the reach of all. We, of all organizations, are best suited to render this service so dependent on electrical energy for its existence.

The cost of adequate lighting is not prohibitive, and the attitude of those already contacted in our experience, is enthusiastically receptive. Therefore we feel justified in our belief that in pursuing this campaign, the best interests of the public and of the utility are being mutually served. We, on our part, extend to the public our specialized knowledge of the new science of seeing, and receive in return increased revenue and measure of good-will that may be sought, but not bought.

# Domestic Consumption and Revenue Holding Their Own

By G. J. Mickler, B.A.Sc., Sales Department, H.E.P.C. of Ontario

WHILE in many lines of endeavour the consumption and revenue during the past four or five years have been on a steady decline, those of the domestic consumers served by Hydro municipalities in the Province of Ontario have been either steadily increasing or holding their own. That is to say, there has been no sharp reduction in the consumption of electricity by domestic users as a whole in this province, nor has the domestic revenue declined in spite of the severe period of depression through which we have been passing.

From the years 1929 to 1933 there was a marked increase in consumption and revenue, even in the smaller municipalities, and in both of these items there has been an increase almost normal up to the end of 1932. It was only in 1933 that this rate of growth was retarded.

For the past number of years figures have been published from year to year to show just what has been taking place in the domestic field. Tables and graphs have been presented to illustrate the growth in consumption and revenue as well as other important facts regarding the use of electricity by householders in Ontario. These figures have been brought up to date and are presented herewith.

Table No. I gives data for cities of over 10,000 population, showing the annual revenue, kilowatt-hours consumed, number of consumers, the

TABLE NO. I

Data for Cities over 10,000 Population

DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 12 | $ 614,925.00 | 12,646,400 | 55,597 | 4.86c | $1.06 | 21.8 |
| 1917 | 19 | 1,063,264.00 | 36,693,100 | 107,248 | 2.89 | .88 | 30.5 |
| 1920 | 21 | 1,926,924.00 | 84,328,000 | 154,186 | 2.29 | 1.11 | 48.4 |
| 1923 | 21 | 3,772,416.00 | 206,266,200 | 223,028 | 1.83 | 1.53 | 83.5 |
| 1926 | 21 | 5,374,069.00 | 324,290,285 | 255,109 | 1.66 | 1.80 | 108.0 |
| 1929 | 26 | 7,530,748.75 | 497,102,897 | 309,645 | 1.51 | 2.08 | 137.2 |
| 1930 | 26 | 7,921,316.00 | 541,876,998 | 315,611 | 1.46 | 2.11 | 144.4 |
| 1931 | 26 | 8,209,397.40 | 567,940,095 | 322,613 | 1.45 | 2.14 | 148.3 |
| 1932 | 26 | 8,491,082.70 | 593,618,860 | 323,844 | 1.43 | 2.18 | 152.8 |
| 1933 | 26 | 8,495,321.93 | 595,211,863 | 330,597 | 1.43 | 2.14 | 150.0 |

## TABLE NO. II
### Data for Towns over 2,000 Population
DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 19 | $ 90,330.00 | 1,414,500 | 7,410 | 6.38c | $1.11 | 17.4 |
| 1917 | 27 | 180,075.00 | 3,824,600 | 15,731 | 4.71 | 1.01 | 21.4 |
| 1920 | 36 | 353,915.00 | 10,053,100 | 24,041 | 3.50 | 1.26 | 36.0 |
| 1923 | 43 | 651,499.00 | 25,411,300 | 34,135 | 2.56 | 1.57 | 60.1 |
| 1926 | 48 | 1,037,016.00 | 50,487,035 | 47,873 | 2.05 | 1.84 | 89.6 |
| 1929 | 54 | 1,474,547.24 | 68,283,456 | 57,699 | 2.16 | 2.11 | 97.8 |
| 1930 | 54 | 1,468,194.00 | 73,234,125 | 58,490 | 2.01 | 2.10 | 105.0 |
| 1931 | 58 | 1,541,490.08 | 78,359,573 | 61,583 | 1.97 | 2.13 | 108.1 |
| 1932 | 59 | 1,595,906.55 | 81,054,613 | 62,843 | 1.97 | 2.11 | 107.5 |
| 1933 | 60 | 1,584,772.57 | 82,321,996 | 63,910 | 1.92 | 2.07 | 107.3 |

average cost per kilowatt-hour, the average monthly bill and the average monthly consumption per consumer and a study of this Table will show that, as stated above, there has been a steady increase in the revenue and consumption up to the end of 1932 and even in 1933 the consumption advanced slightly. There was a slight reduction in the average monthly consumption and a slight reduction in the average monthly bill.

## TABLE NO. III
### Data for Villages under 2,000 Population
DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 18 | $ 24,913.00 | 291,000 | 1,859 | 8.55c | $1.10 | 13.1 |
| 1917 | 77 | 97,516.00 | 1,412,500 | 8,334 | 6.90 | .96 | 14.0 |
| 1920 | 109 | 233,819.00 | 3,829,900 | 15,665 | 6.00 | 1.29 | 21.2 |
| 1923 | 142 | 531,505.00 | 11,249,100 | 29,689 | 4.72 | 1.59 | 33.7 |
| 1926 | 174 | 942,309.00 | 29,945,632 | 46,900 | 3.15 | 1.71 | 54.4 |
| 1929 | 193 | 1,251,564.03 | 46,755,369 | 57,075 | 2.68 | 1.80 | 67.2 |
| 1930 | 194 | 1,363,210.00 | 55,917,187 | 59,159 | 2.43 | 1.95 | 80.1 |
| 1931 | 205 | 1,475,204.49 | 58,484,789 | 63,270 | 2.52 | 1.98 | 78.4 |
| 1932 | 213 | 1,589,233.10 | 66,226,945 | 65,928 | 2.40 | 2.01 | 83.7 |
| 1933 | 214 | 1,559,083.62 | 64,651,543 | 66,371 | 2.41 | 1.96 | 81.2 |

## TABLE NO. IV
### All Municipalities Totalled

DOMESTIC SERVICE

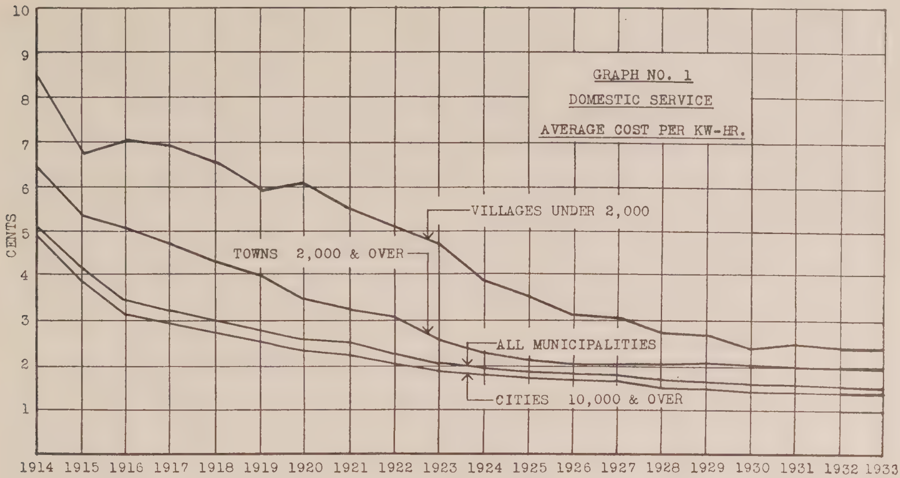
| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 49 | $ 730,168.00 | 14,359,100 | 64,866 | 5.08c | $1.06 | 21.0 |
| 1917 | 123 | 1,340,855.00 | 41,930,200 | 131,313 | 3.20 | .91 | 28.6 |
| 1920 | 166 | 2,514,658.00 | 98,211,000 | 193,892 | 2.56 | 1.15 | 44.6 |
| 1923 | 206 | 4,955,420.00 | 242,926,600 | 286,852 | 2.04 | 1.54 | 75.7 |
| 1926 | 243 | 7,353,394.00 | 404,722,959 | 349,882 | 1.81 | 1.79 | 98.4 |
| 1929 | 273 | 10,256,860.02 | 612,141,722 | 424,419 | 1.67 | 2.05 | 122.5 |
| 1930 | 273 | 10,752,720.00 | 671,028,310 | 433,260 | 1.61 | 2.09 | 130.1 |
| 1931 | 289 | 11,226,091.97 | 704,784,457 | 447,466 | 1.59 | 2.12 | 133.0 |
| 1932 | 298 | 11,676,222.35 | 740,900,418 | 452,615 | 1.57 | 2.15 | 136.4 |
| 1933 | 300 | 11,639,178.12 | 742,195,402 | 460,878 | 1.57 | 2.10 | 134.2 |

Table No. II gives data for towns over 2,000 population and in this Table it will be seen that the consumption has increased slightly during the year 1933 but the revenue is little less than that of the previous twelve months. The average cost per kilowatt-hour, the average monthly bill and the average monthly consumption all declined a little but the decline is so small as to give no immediate cause for concern.

Table No. III gives data for villages under 2,000 population. In the case of village consumers both the revenue and the consumption declined in the year 1933 and the average monthly bill and the average monthly consumption did likewise. It is not surprising that this is the case because, while in the cities and larger towns there has been some activity in the merchandising field and the loss in consumption and revenue caused by some consumers economizing is offset by the use of new appliances by others, in the smaller municipalities this has not been the case; the merchandising activity in these centres is negligible and the lack of employment has perhaps induced the residents in smaller places to economize more than is necessary in larger places.

Table No. IV gives data for all municipalities in the Province and taken as a whole domestic consumption has increased slightly during 1933 while the revenue suffered a decline. The average cost per kilowatt-hour remained the same and the average monthly bill declined, as did the average monthly consumption.

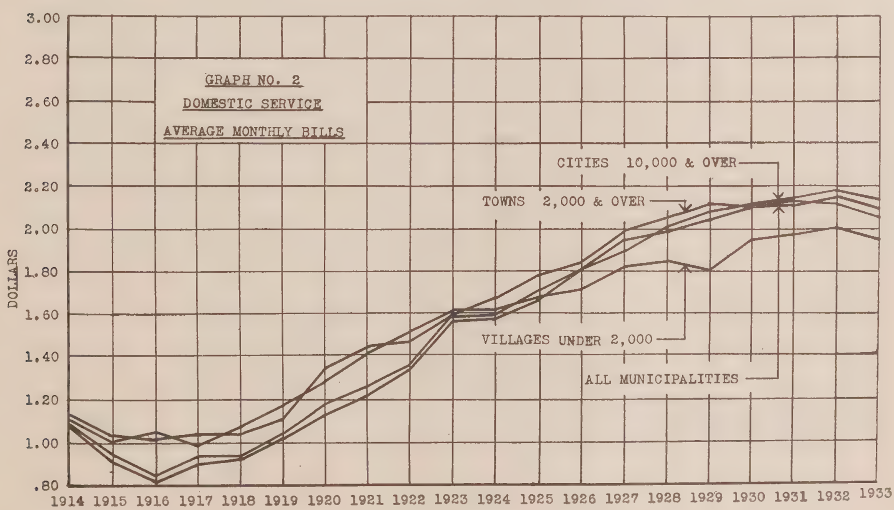
It might be interesting to note here that one reason for the fact that domestic consumption has held up is the introduction of the Hydro Flat Rate Water-Heater Campaign, the effects of which were just being felt at the end of 1933. It is expected that during the year 1934 consumption among domestic consumers will

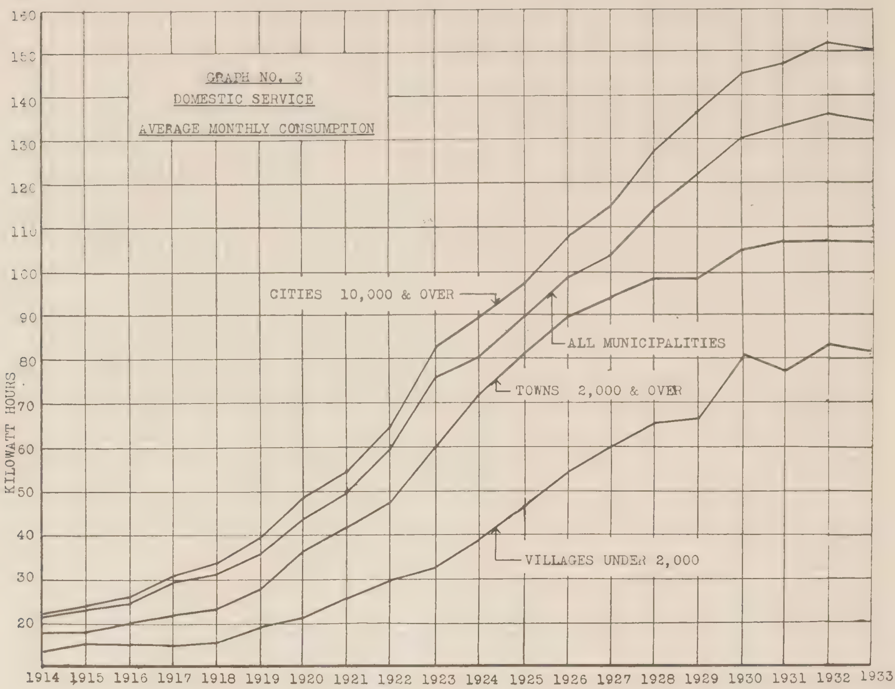


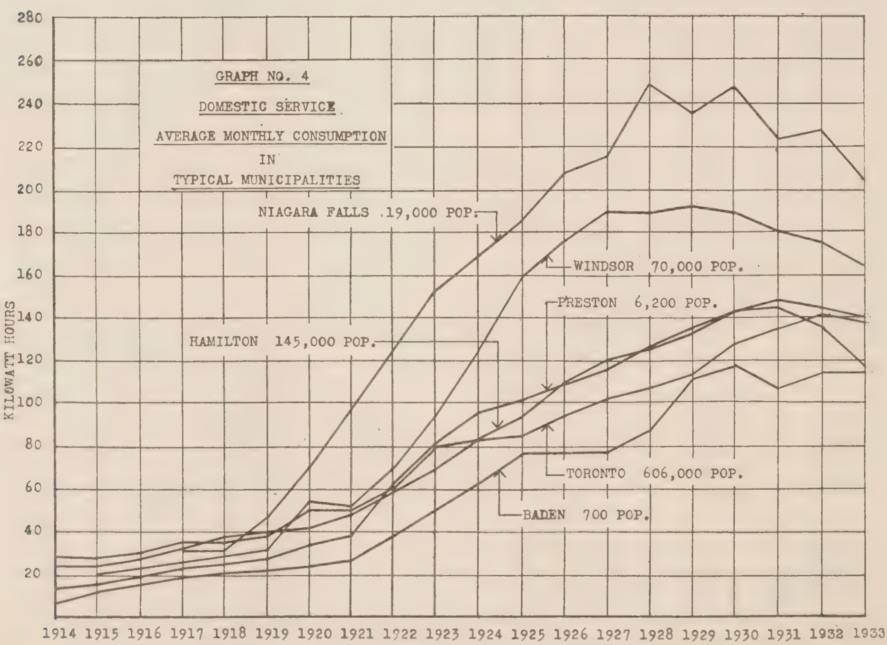

be considerably increased due to the same cause.

One of the outstanding conclusions to be drawn from the figures presented in these Tables is the fact that while power loads the world over have declined to an alarming degree, since 1930 the use of electricity by domestic consumers has not only shown no decline but has grown steadily and it seems as though a development of load among domestic consumers is exceedingly desirable if stability is to be maintained.

That there is a vast field awaiting cultivation among domestic users is revealed by the fact that the average monthly consumption among domestic users in Ontario is but 134.2 kilowatt-hours or 1,610 kilowatt-hours per annum compared with a possible consumption of nearly 8,000




GRAPH NO. 3
DOMESTIC SERVICE
AVERAGE MONTHLY CONSUMPTION
CITIES 10,000 & OVER
ALL MUNICIPALITIES
TOWNS 2,000 & OVER
VILLAGES UNDER 2,000
KILOWATT HOURS
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933


GRAPH NO. 4
DOMESTIC SERVICE
AVERAGE MONTHLY CONSUMPTION
IN
TYPICAL MUNICIPALITIES
NIAGARA FALLS 19,000 POP.
WINDSOR 70,000 POP.
PRESTON 6,200 POP.
HAMILTON 145,000 POP.
TORONTO 606,000 POP.
BADEN 700 POP.
KILOWATT HOURS
20
40
60
80
100
120
140
160
180
200
220
240
260
280
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

kilowatt-hours per annum for an average home. The field is apparently only 20 per cent. developed.

To further illustrate the effect of time on Hydro development a few charts are presented which are self explanatory.

Graph No. 1 shows the average cost per kilowatt-hour for each of the four groups which go to make up Tables I to IV.

Graph No. 2 shows the gradual growth in the average monthly bills among domestic consumers for the same groups.

Graph No. 3 shows the average monthly consumption per domestic consumer similarly classified.

Graph No. 4 presents a picture showing the varying effects of the depression upon the consumption in typical municipalities in each group.

An interesting observation is to the effect that in Hamilton and Toronto the decline in average monthly consumption has been far less than it has in the Border municipalities where apparently the population is more quickly affected by adverse conditions than elsewhere.

Another interesting graph on this chart is that of Preston where there has been a decline in the average monthly consumption due in a large measure to the fact that a large number of electric ranges has been removed from the service very largely because it has been costing too much to keep these ranges in repair. In the village of Baden the consumption is holding its own.

While the Domestic users in Ontario have been doing a good job of holding their position, the Commercial lighting users of the Province have also shown a wonderful record. It is to be expected with a marked decline in the use of power for lighting purposes in industrial plants for office lighting, and other purposes, there

TABLE NO. V

Data for Cities over 10,000 Population

COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 12 | $ 536,350.00 | 14,048,500 | 12,439 | 3.80c | $3.94 | 103.7 |
| 1917 | 19 | 642,989.00 | 27,479,800 | 19,573 | 2.34 | 2.96 | 126.6 |
| 1920 | 21 | 1,103,599.00 | 50,358,000 | 25,505 | 2.19 | 3.77 | 172.0 |
| 1923 | 21 | 2,043,197.00 | 91,146,500 | 32,016 | 2.25 | 5.56 | 246.9 |
| 1926 | 21 | 3,393,186.00 | 147,581,714 | 40,675 | 2.30 | 7.08 | 308.0 |
| 1929 | 26 | 4,772,209.30 | 230,263,364 | 48,713 | 2.07 | 8.49 | 401.5 |
| 1930 | 26 | 4,919,496.00 | 242,278,308 | 50,046 | 2.03 | 8.31 | 409.6 |
| 1931 | 26 | 5,137,591.45 | 256,281,236 | 52,203 | 2.00 | 8.37 | 417.7 |
| 1932 | 26 | 5,088,113.49 | 254,512,316 | 51,753 | 2.00 | 8.19 | 409.8 |
| 1933 | 26 | 4,910,798.54 | 242,854,622 | 51,769 | 2.02 | 7.90 | 390.9 |

## TABLE NO. VI
### Data for Towns over 2,000 Population
COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 17 | $ 71,457.00 | 1,362,000 | 2,393 | 5.25c | $2.61 | 49.8 |
| 1917 | 27 | 134,730.00 | 3,100,600 | 4,107 | 4.35 | 2.76 | 63.5 |
| 1920 | 36 | 221,867.00 | 6,179,400 | 5,736 | 3.59 | 3.30 | 91.8 |
| 1923 | 43 | 315,530.00 | 9,598,000 | 7,086 | 3.29 | 3.76 | 114.3 |
| 1926 | 48 | 430,467.00 | 15,709,616 | 8,310 | 2.74 | 4.31 | 160.0 |
| 1929 | 54 | 632,010.30 | 26,240,436 | 10,214 | 2.41 | 5.13 | 213.1 |
| 1930 | 54 | 661,857.00 | 27,841,568 | 10,274 | 2.38 | 5.38 | 226.4 |
| 1931 | 58 | 698,127.87 | 29,950,671 | 10,979 | 2.33 | 5.43 | 232.3 |
| 1932 | 59 | 723,774.94 | 31,786,728 | 11,359 | 2.28 | 5.31 | 233.2 |
| 1933 | 60 | 663,596.72 | 29,864,388 | 10,966 | 2.22 | 5.04 | 226.9 |

would be a considerable decrease in the use of electricity by this class of user, but as an actual fact the consumption and revenue produced by commercial consumers in Ontario have not suffered to any serious extent during the last four years.

Table No. V gives data for cities of over 10,000 population and under the same headings as the Tables for

## TABLE NO. VII
### Data for Villages under 2,000 Population
COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 14 | $ 16,974.00 | 259,200 | 825 | 6.55c | $1.74 | 26.6 |
| 1917 | 77 | 82,756.00 | 1,403,100 | 3,773 | 5.86 | 1.87 | 31.7 |
| 1920 | 109 | 152,497.00 | 2,799,500 | 5,255 | 5.89 | 2.45 | 45.0 |
| 1923 | 142 | 254,530.00 | 4,738,100 | 7,281 | 4.80 | 2.96 | 55.1 |
| 1926 | 173 | 352,942.00 | 8,505,684 | 9,459 | 4.15 | 3.22 | 77.7 |
| 1929 | 193 | 488,997.65 | 15,839,530 | 11,179 | 3.08 | 3.70 | 119.9 |
| 1930 | 193 | 513,518.00 | 17,718,146 | 11,553 | 2.89 | 3.76 | 129.9 |
| 1931 | 205 | 541,801.47 | 18,889,733 | 12,104 | 2.86 | 3.76 | 131.0 |
| 1932 | 213 | 590,994.43 | 20,297,499 | 12,593 | 2.91 | 3.91 | 134.3 |
| 1933 | 214 | 575,396.85 | 19,616,479 | 12,708 | 2.93 | 3.77 | 128.6 |

## TABLE NO. VIII
### All Municipalities Totalled
### COMMERCIAL LIGHTING SERVICE

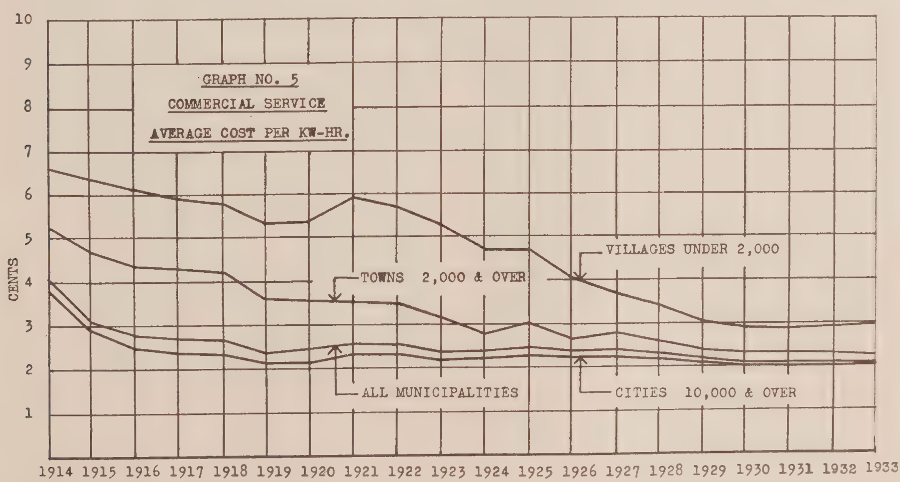
| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 43 | $ 624,781.00 | 15,669,700 | 15,657 | 4.00c | $3.63 | 90.8 |
| 1917 | 123 | 860,475.00 | 31,983,500 | 27,453 | 2.69 | 2.77 | 103.1 |
| 1920 | 166 | 1,477,963.00 | 59,336,900 | 36,496 | 2.50 | 3.51 | 140.0 |
| 1923 | 206 | 2,613,257.00 | 105,482,600 | 46,383 | 2.46 | 4.80 | 195.6 |
| 1926 | 242 | 4,176,595.00 | 171,797,014 | 58,444 | 2.43 | 6.08 | 250.0 |
| 1929 | 273 | 5,893,217.25 | 272,343,330 | 70,106 | 2.16 | 7.11 | 328.6 |
| 1930 | 273 | 6,094,871.00 | 287,838,022 | 71,873 | 2.11 | 7.15 | 337.8 |
| 1931 | 289 | 6,377,520.79 | 305,121,640 | 75,286 | 2.09 | 7.20 | 344.3 |
| 1932 | 298 | 6,402,882.86 | 306,596,543 | 75,705 | 2.09 | 7.05 | 337.5 |
| 1933 | 300 | 6,149,792.11 | 292,335,489 | 75,443 | 2.10 | 6.79 | 322.9 |

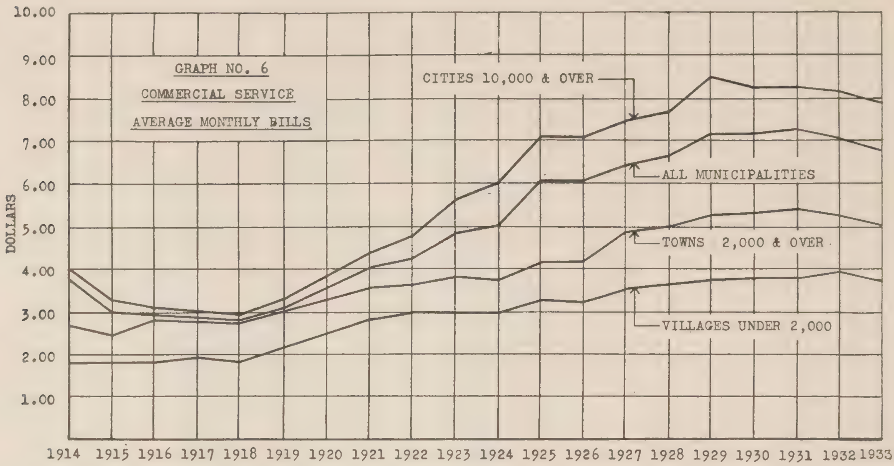
domestic users. In this Table it will be seen that up to November, 1931, the consumption increased steadily and since that time there has been a slight decrease in the total use. The total revenue followed the same trend. The average cost per kilowatt-hour advanced slightly while the average monthly bill and the average monthly consumption also showed a small decrease.

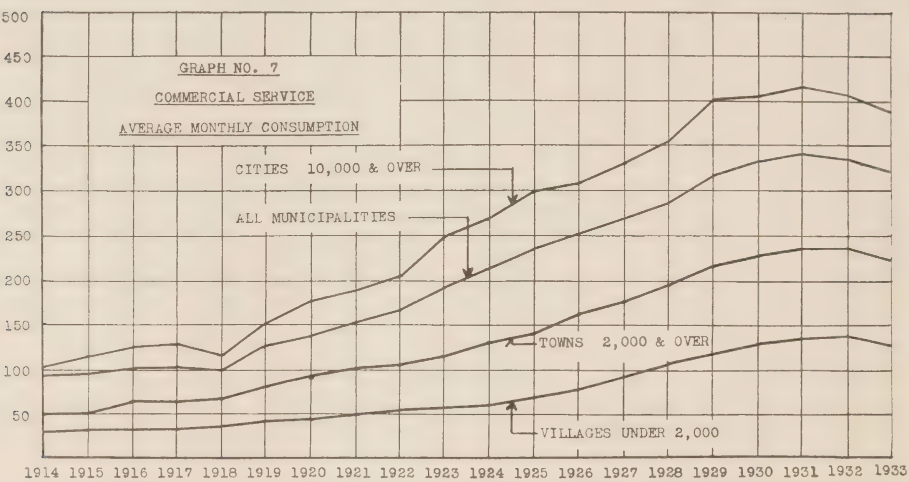
Table No. VI gives similar data for towns over 2,000 population and the same general characteristics apply to this Table as to the previous one.

Again, in Table No. VII for villages under 2,000 population the same facts in general apply.

In Table No. VIII we see the cumulative effect of the depression on this class of consumer. It is interesting indeed to see that up until 1932 both






consumption and revenue increased, and it was only in 1933 that any decrease in either of these items showed itself. It is expected that in the year 1934 both revenue and consumption will again be on the up grade.

The figures on commercial lighting contained in these Tables are also graphically illustrated in graphs Nos. 5, 6 and 7.

There is no yardstick by which the possible consumption among commercial consumers can be measured or gauged so that it is difficult to tell to what extent this field has yet to be developed. Suffice it to say that remarkable progress has been made in the past few years in the art of illumination and that the lighting installations of many commercial users are woefully inadequate to meet their needs both for safety and health of employees. Should the depression lift, even temporarily, it is safe to say that a marked improvement in store lighting, factory and office lighting will manifest itself with corresponding increase in commercial lighting consumption and revenue among Hydro users.

# The New Edition of the Canadian Electrical Code

By E. W. McLeod, Testing Engineer, H.E.P.C. of Ontario Laboratories

THE third edition of Part I of the Canadian Electrical Code which covers Essential Requirements and Minimum Standards for Electrical Installations has recently been issued as a Canadian standard and goes into effect early in 1935. This edition recognizes progress which has been made in the electrical industry since 1930, the year in which the second edition of the Code was issued. There are numerous revisions and deletions of clauses appearing in the 1930 Code as well as additions of new clauses in this third edition.

It is the intention to have Part I of the Code issued at regular intervals, every two years, if possible, in order that it may be kept more nearly in line with developments in the electrical industry and with experience gained in the field.

In order to eliminate as far as possible undue hardship on industry in attempting to place new devices on the market which may require methods of installation not specifically covered in the latest edition of the Code, a procedure has been established whereby interim Code recognition may be secured for such devices. Particulars regarding the procedure to be followed may be obtained from the Secretary of the Canadian Engineering Standards Association, Room 3064, National Research Building, Ottawa. It is hoped that in this way inspection authorities and industry will be kept fully posted at all times on matters pertaining to the Code.

In compiling the third edition of the Code, requirements dealing specifically with details of construction of equipment and apparatus have been omitted as far as was practicable. Thus, an attempt was made to limit Part I of the Code to requirements for the installation of equipment. It was deemed advisable to have requirements for details of construction of equipment covered in Part II of the Code, which consists of specifications covering details of construction and tests to be applied to various pieces of electrical equipment and apparatus. Some of these specifications have already been issued and others are in course of preparation.

The main changes from the 1930 Code which appear in the new 1935 edition are briefly outlined below. In several instances these changes will permit of installations which can undoubtedly be made at lower costs without in any way sacrificing safety. A few changes will temporarily increase the costs of installations but these changes were included because field experience plainly indicated that they were necessary in the interests of public safety mainly because of the increased use of electrical equipment in proximity to materials of an explosive or otherwise hazardous nature, e.g., in gasoline service stations, spray booths, etc. It is not the intention of this Article however, to go into details of costs but to outline briefly

the features of major importance which have been introduced into this third edition. These are summarized as follows.—

### Service-Entrance Cable

On receiving special permission from the inspection authority, a new type of cable, known as service-entrance cable, may now be used as well as the well-known rigid or flexible conduit or armoured cable with lead sheathing to make connections from power lines to the customers' service equipment.

### Bare Neutral

The installation of bare neutral conductors in services is now recognized under certain restricted conditions of service and this method may be adopted upon receiving special permission from the inspection authority.

### New Sequence of Service Equipment

New rules will permit the service meter to be connected on the line side of service equipment where formerly it was required to be connected only on the customers' side of the service-box. This new sequence is permitted under certain restrictions which are definitely pointed out in the Code. This sequence has numerous advantages, among them being the one which permits the installation of the meter outside the customer's residence, with the result that the Utility has access to the meter at all times and the meter can be read without disturbing the householder. It also makes theft of current much more difficult if not impossible.

### Demand Factor for Single Ranges

The demand factor for one range (as in residence installations) has been reduced from 100 per cent. to 80 per cent. This permits the use of smaller service conductors and for installations consisting of one range circuit and six branch lighting circuits (quite a common residence installation) 60 ampere instead of 100 ampere service equipment. This obviously will reduce costs of installations and coupled with the permission to use service-entrance cable and bare neutrals, a resulting overall saving in the cost of each residence installation is assured. It is also quite possible that a further saving in labour costs will be effected, due to simplification in wiring made possible by the new meter sequence referred to above.

According to the new Code, the service switch and fuses (service-box) may be omitted provided that approved branch-circuit breakers are used in the branch circuits. There are certain other restrictions which have to be complied with which limit such installations practically to residences in which the load does not exceed 100 amperes, and the service meter is connected on the line side of the breakers.

### Wiring Between Grouped Switches

Switches which are grouped at distribution centres are now required to be supplied with wiring gutters or their equivalent for enclosing the wires between these switches. The rule covering this is intended to apply not only at service entrances but also wherever switches are grouped, as,

for example, at load centres in factories.

### Underfloor Raceways

The use of underfloor raceways has been extended to those installations requiring conductors up to and including No. 8 B. & S. gauge. Formerly such raceways were limited to installations in which the loads did not exceed 15 amperes at 125 volts and 10 amperes at 125-250 volts.

### Auxiliary Gutters

Code recognition has now been extended to auxiliary gutters used to enclose conductors at the backs of switchboards; to wireways and busways used for enclosing the conductors of power and lighting circuits for distribution around buildings; and to bare busbars and risers in buildings of fire-resistive construction. Some of these systems furnish methods of installation which are alternative to rigid conduit, armoured cable, etc., which have been in existence for some time.

### Branch Circuits on Panelboards

A new limit has been set on the number of branch circuits which may be connected to panelboards. Panelboards shall now have provision for not more than 42 single or 20 double branch circuits. It is felt that by limiting the number of branch circuits connected to any one panelboard, less trouble will result from heating than has been the general experience heretofore in panelboards having circuits in excess of the numbers mentioned above.

### Demand Factors for Grouped Range Installations Reduced

The demand factors for feeders supplying several ranges, as, for example, in apartment-house installations, have been reduced from those specified in the 1930 Code, mainly from the fact that field experience has indicated that this is possible without sacrificing safety. This permits the use of smaller sizes of conductors with resulting saving in cost.

### Motor-Circuit Switches

Other rules require a switch, generally known as a motor-circuit switch, which is new to the Code. This type of switch is usually of more rugged construction and is capable of passing more severe tests than those applied to switches heretofore used. On the basis of these tests horsepower ratings are assigned to motor-circuit switches. It might be of interest to note that tests for horsepower ratings include those intended to approximate conditions which may occur when the rotor of a motor becomes stalled as, for example, when bearings seize. Field experience as based on other types of switches has very definitely indicated the necessity for this type of switch.

### Low Voltage Protection and Fuses

It might be noted that low voltage protective devices are now required on motors over 5 horsepower capacity whereas the former limit was 2 horsepower.

It might also be noted in connection with protection of circuits that there is a new rule which now permits plug

fuses to be used on a 250-volt two-wire circuit tapped from a 125-250-volt system. The only proviso is that the voltage to ground from any conductor of such a circuit shall not exceed 150 volts.

It is no longer permissible to parallel fuses in order to protect circuits in which the currents exceed 600 amperes (600 amperes being the largest standard cartridge fuse now being manufactured in voltages of 600 and less.) Formerly it was permissible to parallel, for example, two 400 ampere fuses to protect a circuit in which the currents were of values exceeding 600 amperes, and ranging between 600 and 800 amperes. This practically means that circuit-breakers must be depended upon for the protection of such circuits.

### GROUNDING

It is no longer necessary to ground outlet and junction boxes used with non-metallic underfloor raceways.

Maximum values of resistance have been set for "artificial grounds", "metallic water piping system grounds" and "grounding systems". in the first two instances the maximum permissible resistance is 25 ohms and in the latter case 6 ohms. With but few exceptions no conductors smaller than No. 8 B. & S. gauge are now permitted for the purpose of grounding either systems or non-current-carrying metal parts of equipment. Formerly it was permissible to ground non-current-carrying metal parts of devices drawing relatively low currents with a No. 14 B. & S. gauge conductor.

### USE OF EXPLOSION RESISTING EQUIPMENT

In installations where serious fire or explosion hazards exist as, for example, in dry-cleaning establishments, spray-painting shops, etc., special equipment known as explosion-resisting equipment must be used. This means that conduit fittings, enclosures for switches, lamps, etc., are required to be of the explosion-resisting type. Rigid conduit must of course be used in such installations and special care is to be taken to have it properly sealed with a suitable sealing compound which will prevent explosive gases or liquids from getting into the runs of conduit.

### RADIO GROUNDS

In connection with radio rules, it should be noted that No. 8 B. & S. gauge grounding conductors are now required in place of the No. 14 B. & S. gauge which were formerly permitted. The rules have been extended to include certain requirements covering radio transmitting stations.

The Code has recognized advancement in X-ray and therapeutic technique by adding a new section covering X-ray and high-frequency apparatus.

The section covering electrical communication systems has been almost completely revised.

The above is a summary of what might be considered the outstanding changes which appear in the new Code. It should be understood of course that there are numerous other changes in clauses as they appeared in the 1930 Code. All of these changes cannot be covered in the space allotted to this article. It is therefore recommended to anyone vitally interested in Part I of the Code that the new edition be carefully reviewed in detail. Copies of the new

Code may be secured from your local Hydro Inspection Office. (25c. each).

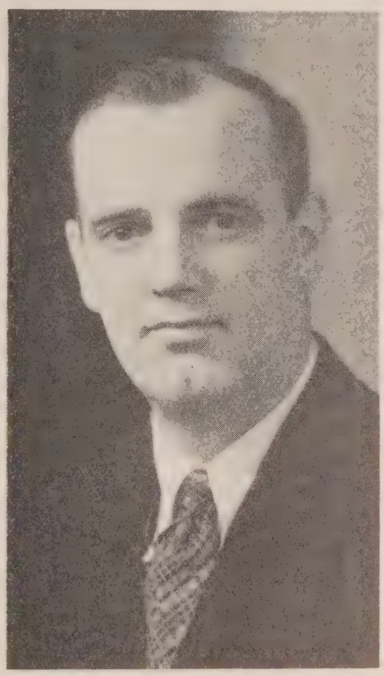
In conclusion, it may be of interest to note that while in general the changes appearing in the new Code tend to lower costs of installations, they all should result in improvement of safety conditions.

# A Boy's Life Saved

On June 29, 1934, Freeman Bondy, Jerry Crowe, and Lloyd Evoy were raising a boat from Mitchell's Bay, while Donald Bondy and Billy Crowe, young sons of two of the men, played in a boat nearby. Mr. Bondy looked up from his work and noticed that one of the boys was missing, and bubbles coming from the water. He dived in fully dressed, and on his second attempt brought up his son.

Lloyd Evoy placed the boy in position, and after 15 minutes application of the Prone Pressure Method of Artificial Respiration was successful in resuscitating him.

Lloyd Evoy has been in the Operating Department of the Commission since June 15, 1921, and is at the present time an operator in the Kent Station near Chatham. The National Safety Council awarded the President's Medal to Mr. Evoy for the successful resuscitation of Donald Bondy. The presentation took place in Kent Station on Wednesday, December 5th.



*Lloyd Evoy*

Prior to the presentation, Mr. Evoy was in receipt of the following letter from the Chairman:—

November 29th, 1934.

Mr. Lloyd Evoy,
88 Richmond St.,
Chatham, Ontario

Dear Mr. Evoy:

It has been brought to my attention that you have been awarded the President's Medal of the National Safety Council of the United States for your resourcefulness and perseverance in the resuscitation of a young lad recovered from the waters of Mitchell's Bay. The information I have received states that after fifteen minutes application of the prone pressure method of resuscitation, you were able to save the life of this little lad.

I am glad to hear that you have been awarded this medal, and to send

*Donald Bondy*

you my congratulations. I hope your example will lead to employees of the Commission generally keeping up the practice of resuscitation methods in relation to the operations of the Commission. The lives of many men engaged in the electrical industry, suffering accidental shock, have been saved by the application of methods of artificial respiration, and there is need for the most widespread diffusion of information in all cases in which the Commission's employees have been able to save life by their prompt action.

I hope it will be possible that this letter to you may be brought to the notice of those attending the presentation of the medal to you at Chatham on Wednesday next.

Faithfully yours,

T. S. LYON, *Chairman.*

The presentation was made by Wills Maclachlan, acting on behalf of the President of the National Safety Council. There were present Mayor I. L. Davis of Chatham, Chairman F. Biette of the Chatham Public Utilities Commission, Manager R. S. Reynolds of the Chatham Public Utilities Commission, the Manager of the Wallaceburg Hydro-Electric Commission; the Rural Superintendents with their staffs from Chatham R.P.D., Merlin R.P.D., Blenheim R.P.D., Wallaceburg R.P.D., Bothwell R.P.D., and Ridgetown R.P.D. Mr. James Smith, the Operator-in-Charge at London, officially represented the Operating Department. The Operator-in-Charge of Essex Station, and the Operator-in-Charge and staff of Kent Station, were also present.

Mr. Freeman Bondy and his son Donald Bondy were present, and Donald Bondy read and presented to Mr. Evoy the following letter:—

Chatham, Ont. Dec. 5, 1934.

Dear Mr. Evoy:

I sincerely wish to thank you for the greatest of favours that you did


*The President's medal of the National Safety Council.*

for me when you saved me from drowning and I want you to know that I will always be indebted to you for more than I can ever repay.

Donald Bondy.

During the presentation of this letter, Donald completely broke down. He certainly was not alone in this. Mr. Evoy wished to disclaim all credit for his action, feeling that any Hydro man would have done as he had done. He felt that the training that he had received made his action possible. Others who spoke emphasized the necessity of training and practice, but honoured Mr. Evoy for his presence of mind in the emergency in being able to put his training into effect, and so save the boy's life.

# Weatherproof Wire

By R. E. Jones, Distribution Section, Electrical Engineering Department, H.E.P.C. of Ontario

THE covering commonly supplied on weatherproof wire, sometimes erroneously referred to as insulation, should be considered only as giving a mechanical separation between the conductor and any object in contact with the covering. While new the covering has a certain insulating value but this is rapidly lost by the action of the weather.

The covering consists of two or three layers of loose braid of cotton yarn with an impregnation of some form of asphaltic compound. Some manufacturers apply a final coat of wax.

About 1920 it was observed by Utilities in Chicago that more recently supplied weatherproof wire had not the weathering qualities of the earlier material. The result was a thorough investigation into the subject by the Engineering Experiment Station of Purdue University in co-operation with the Utilities Research Commission. The work was carried out by Messrs. Carter, Olson, Harding and Shreve of Purdue University.

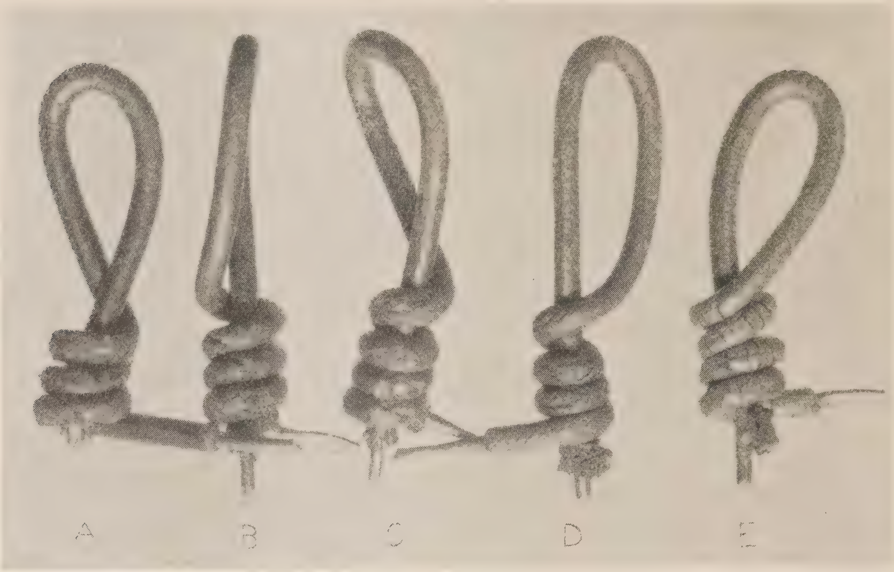
It was found that in the past the saturant used was a natural asphalt. Often each layer of braid was treated separately and the whole process was slow. To reduce the cost of the wire the manufacturers turned to petroleum base asphalt and in most cases impregnated all the braids at one time. To speed up the process low melting point saturant was used, often with the addition of wax tailings.

After consideration of the cost of replacing weatherproof wire at relatively frequent periods, the need of a new type of wire became more urgent.

An analysis was made of the various saturants in use and tests were carried out to ascertain the effect of heat and cold, and the weather on the different compounds.

The final result was the development of a new saturant known as Blown Asphalt. The difference between this material and the older type is that air is blown through the heated petroleum residue instead of steam. The resulting asphalt will not flow at as low a temperature as the old and is not brittle when cold. It will also withstand the weather much longer.

For the use of blown asphalt a somewhat higher temperature is required in the impregnating bath. Tests showed that the annealing effect




*The result of twisting conductors around their own diameter at 70 deg. fahr. In A, B, C and D the braiding was broken through to the copper by the bending; in E (U.R.C. wire) the outer finish was cracked but the braids were unbroken.*

of this higher temperature on copper would not cause a reduction of strength exceeding 4 per cent. if the immersion was continued to 30 minutes. The wire with the covering impregnated with this new saturant is commonly known as U.R.C. Wire (Utilities Research Commission). The term "weatherproof" has been replaced by "Weather Resistant".

Recently samples were obtained of the U.R.C. wire together with samples of the weatherproof wire turned out by four manufacturers in Canada.

Specimens have been placed in the weatherometer and results will be available later.

The illustration shows the result of twisting the conductors around their own diameters at 70 degrees fahr. In specimens A, B, C, and D the braid was broken through to the copper by the bending. In E, the U.R.C. wire, the outer finish was cracked but the braids were unbroken.

Pieces of weatherproof wire were placed in an oven and the temperature was maintained at 275 degrees fahr. for an hour. On one specimen the wax finish had formed in drops on the underside, the U.R.C. wire had small blisters on its surface, and the rest of them had the threads exposed due to evaporation of the wax finish. When hot all samples except the U.R.C. were soft as though the braids contained no saturant. They all hardened again on cooling.

Tests were made to determine the voltage breakdown on the various makes of wire when new. Later, voltage tests will be made on the specimens now in the weatherometer. The wires showed a wide variation in voltage strengths, running from 3,000 to 4,830 while dry, and

from 1,200 to 2,140 after 1½ hours immersion in water.

One large United States utility makes a practice of salvaging all material possible, including weatherproof wire. Lengths of 25 ft. and greater are spliced with a welding machine for service work. The larger sizes in lengths exceeding 50 feet are joined with a sleeve for line use. The joints are then taped and painted. Shorter lengths are cut up into standard tie-wire lengths and shipped out to the job as such. Two short lengths are not joined together. Wire which has the covering bleached but unbroken is dipped in a vat of asphalt base varnish. The use of old weatherproof wire for ties is an idea that could well be utilized on all systems large and small.

While most of the weatherproof wire is medium, hard or soft drawn, hard drawn weatherproof wire is coming more into use. It has the advantage of greater strength and therefore will probably not require resagging. It may be spliced readily with a sleeve and for dead-ending clamps are available. The use of clamps for dead-ending has the advantage of permitting adjustment of sag without cutting the conductor.

While the general practice for many years was to use covered wire for all distribution circuits, in later years many systems have turned to the use of bare wire for lines in excess of 600 volts. A number of utilities have gone a step further and have erected bare conductors for the 115/230 volt secondary. Where the usual spacing on racks has been increased the results have been entirely satisfactory.

On a questionnaire sent out in U.S.A. 16 companies reported as using bare wire for secondaries with savings up to 40 per cent. over the weatherproof. All those using the bare wire are planning to extend its use. Accidents on bare secondaries are reported as rare and troubles are reduced except in some cases where close spacing of conductors was used.

In 1929-1930 several experimental installations of bare secondary were made by the Commission in rural systems.

For any who are interested in further details of the investigation at Purdue University, a complete copy of the report, entitled "Bulletin No. 43, Improved Weather Resistant Coverings for Overhead Line Wires", may be obtained at a price of fifty cents from Engineering Experiment Station, Purdue University, Lafayette, Indiana.

# New Light Sources
## Their Application to Street and Highway Lighting

By C. A. B. Halvorson, Consulting Engineer, General Electric Company, Lynn, Mass.

*(An address delivered before the Electric Club of Toronto, November 7th, 1934. Cuts courtesy The Canadian Engineer.)*

FIRST of all, in studying this question of street and highway lighting, it is well to understand the natural laws which underly night vision. I believe that it is due to the lack of such knowledge by people in general that most accidents occur at night. Most pedestrians believe that they can be seen if they are in the light of automobile headlights. There is no greater fallacy.

If you drove your automobile with street lights in place of headlights, people would say that you were crazy, because with street lamps they associate glare and high intensity; but it is a fact that in the large street lamps, intensities of only about 1,500 beam-candlepower are obtained, whereas in headlights intensities as high as 50,000 beam-candlepower are permitted by the authorities. In automobile headlighting, laws require that at one degree below the horizontal the intensity be 7,500 beam-candlepower. It is further required that there shall be above the horizontal, from oncoming headlights, from 400 to 2,000 beam-candlepower at all times. In other words, we are always confronted on the highway with glaring headlights.

I have here a view taken by the light of standard 32-c.p. headlights. There is a pedestrian 100 ft. ahead of the car, but you cannot see him because his dark clothing reflects very little light back to the eyes, and the type of pavement is such that with the light from the headlights striking the roadway at a low angle of incidence, a very low luminosity is produced, so that in reality darkness surrounds the pedestrian. He is not visible.

In order to have vision at night, it is essential to provide the right kind of pavement. In other words, we must provide a contrast between the individual and the lighted surface, which is usually the pavement. Two methods of vision obtain at night: First, the silhouette method; and second, the subjective method, where the light is reflected from the object. In highway and street lighting, where the intensities are low, relative to indoor lighting, the silhouette type of vision is the more important, and it matters little whether the light be white light, yellow or green, so long as the brightness of the surfaces are of a high degree in order to produce contrast. This is very important in any discussion of the new light sources.

This next view (Fig. 2) shows the subjective method of vision where the pedestrian is in light clothing and is holding a handkerchief in his hand, so that some light comes back to the eye.

*Fig. 1—The author demonstrating a high-intensity mercury-vapour lamp of 14,000 lumens with colour correction by 2,500 lumens of incandescent light from an auxiliary lamp vertically mounted immediately above the mercury-vapour lamp.*

The combination of these two methods (silhouette and subjective) is the ideal.

With headlights giving 50,000 beam-candlepower, if the front wheels of the car be elevated by as much as a pebble, at a distance of a few hundred feet you have the full intensity directly in your eyes.

The highway-lighting problem cannot be solved by headlights. As an example of the light required to see things subjectively in detail, Dr. M. Luckiesh told me recently that he had found that it requires 100,000 foot-candles to give sufficient satisfactory light for threading a needle. In street and highway lighting we are mainly concerned with seeing quickly —with seeing an object such as a truck or a pedestrian in outline, or in bulk, and we are not concerned with details or colour.

### Pavements and Lighting

As I have said, a very important thing in successful street and highway lighting is the nature of the pavement. There are three types of pavement in general use: Concrete, which reflects 30 to 60 per cent. of light, and even 80 per cent. under the best conditions; bituminous macadam, which usually reflects only about 4 per cent. of light; and asphalt, which also usually reflects only about 4 per cent.

Here are three views (Figs. 4, 5 and 6). Fig. 6 is looking directly down on asphalt and on concrete in brilliant sunshine. It indicates the differences in reflection characteristics. In Fig. 5, the appearance, so far as the con-

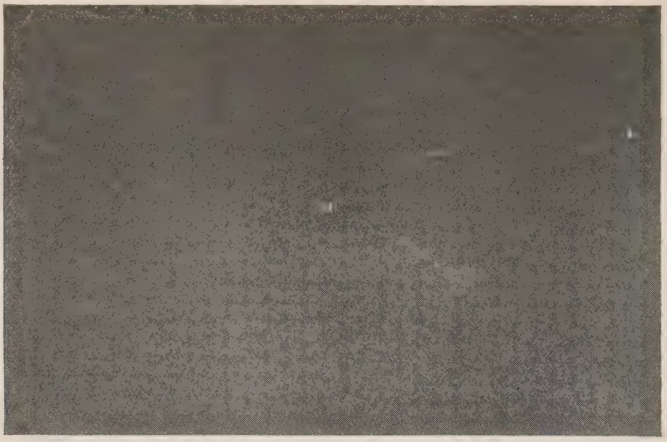


*Fig. 2—Subjective Method of Vision—Pedestrian in light clothing and holding a white handkerchief, 100 ft. ahead of 32-c.p. headlights.*

crete pavement and the asphalt shoulder are concerned, is much the same, even though they reflect in the one case perhaps 60 per cent. of the light and in the other case probably only 4 per cent. But in Fig. 4, looking against a north sky, the shoulder is dark. The point is, that with a brilliant sky in the foreground we find uniform brightness, regardless of colour; and in the other case, we have a difference in the reflectivity of the two types of pavements. Now, in highway lighting, it is essential, if possible, to secure the result shown in Fig. 5 in order to overcome the tremendous difference in reflectivity.

So involved did this whole matter

*Fig. 3—Silhouette Method of Vision—Pedestrian in dark clothing, 100 ft. ahead of car, seen against background of lighted pavement.*

*Fig. 4*

*Fig. 5*

*Fig. 6*

become, that about ten years ago a street-lighting committee was appointed by the Illuminating Engineering Society to study these matters, and from time to time the findings of this committee have been published. Several papers were written covering the technique of street lighting, and about three years ago a code was completed which gives the salient information and data as to the proper methods of securing the best results in any street-lighting project. In the code it says that in the lighting of a highway, the lamps should be mounted high enough to avoid glare, and should overhang the roadway in order to reproduce the effect shown in Fig. 5.

When the lamp is mounted at the correct height, and out over the pavement, a smaller lamp will give illumination that is more satisfactory than will a larger lamp in improper position.

### Losses Through Inadequate Lighting

These things, of course, all affect the pocketbook of a municipality, but they are very essential, because, to quote from a pamphlet recently issued by the lamp people at Nela Park, "you pay for adequate street lighting whether you have it or not." The annual cost of American traffic accidents is $2,500,000,000. The proportion of night accidents is 45 per cent., or $1,125,000,000; and the proportion of night accidents preventable by good street lighting (50 per cent.) amounts to $562,000,000. The actual cost of street crime is $250,000,000, and the proportion of this cost preventable by street lighting (60 per cent.) is $150,000,000. The total annual saving through good lighting would be $712,000,000.

In Massachusetts, with 1,800 miles of improved state highways, figures from the Department of Public Works

show that nearly 50 per cent. of all accidents take place after dark, although there is but 25 per cent. of the travel. And 78 per cent. of all fatalities take place after nightfall, and, generally speaking, where highways are inadequately lighted or not lighted at all.

In New Jersey, approaching Atlantic City, highway lighting has been so satisfactory that the authorities have placed illuminated sign boards reading "Dim Your Lights", because bright headlights are unnecessary.

Think what it would mean to be able to drive along the highways without bright headlights! Not only would it add tremendously to comfort, but it would, of course, save a great many lives.

### Monochromatic Light

As you go about your daily pursuits, you are accustomed to light that covers the whole visible range of the spectrum. If you see a thing that is red to the eye, it is because of the red in the light which is reflected back to the eye. The same applies in regard to all the other colours. But in the case of the sodium lamp, we have no such situation. The light comes solely from a single band in the spectrum, and cannot be changed to a wider range. In sodium light there is no blue and no red light, so that objects seen under sodium light of necessity appear as either black or yellow; there are no other colours.

Now I am going to compare the white light of an incandescent lamp with the monochromatic light of a sodium lamp. I have here two bouquets. They are exactly alike, made up of artificial flowers of precisely the same colour. You see what takes place in the monochromatic light; the yellow remains yellow, but all other colours become black or dark shades of yellow.

You cannot use sodium light where colour distinction is necessary, but you can use sodium light to very good advantage where colour is unimportant. Silhouettes are much more clearly defined in either sodium light or mercury light than in incandescent light, and this fact alone is of importance in establishing the value of these two new light sources for street and highway work, because silhouette vision is of greater value in avoiding collisions and other street accidents than is reflected vision. Sodium lamps have a very definite place in lighting.

### Toronto Meeting Encouraged Research

In 1928 the people of Canada and the United States got together and held an international congress on illumination—right here in Toronto, in fact. We invited authorities from abroad to attend, and conducted them all over the United States and Canada, showing them the best of lighting everywhere, so that we could make them lighting-conscious. We did a good job. They went home and got busy and began to develop new things.

When the depression started on this continent, the first thought was to put out some of the street lamps in order to save power bills and so that the taxpayers could see that something was being done to reduce municipal expenditure. It cost a lot in inconvenience, and in some cases cost

deaths. Abroad they went ahead and lighted more highways than ever before, because they found that it paid them to do so. Furthermore, they developed new sources of light. They developed the sodium-vapour lamp to a commercial stage, and installed it on some of the highways in Holland and Germany, and in England they developed the high-intensity mercury-vapour lamp and installed it in place of many old-fashioned illuminating-gas lamps. Both of these movements have been pushed along very rapidly in England and on the European continent.

### Sodium-Vapour Lamp Installations

In this country and in the United States, the sodium lamp was being studied and developed in the laboratories, but it was regarded more or less as a scientific curiosity. Having been brought up on white light, it took us a long time to see the possibilities of sodium light. But we tried it out on a highway, and people claimed that it gave nine times the visibility of equal incandescent light. Now, I think that we may discount that by a great deal, but in any event we did get busy and develop an alternating current sodium lamp, and you have a very good installation here in Canada—at Three Rivers, Que.—and we have twenty installations in the United States. They are popular and successful, and they are undoubtedly superior for highway lighting.

In the case of the sodium lamp we have a source of great size—12 inches long and 3 inches in diameter—and one can see the sodium deposit on the inside of the bulb. The bulb contains a quantity of neon gas at very low pressure; and when the arc is first struck, the colour of the light emitted is that of neon gas, a red light, with an efficiency of about 8 lumens per watt. The function of the neon gas is to act as a carrier for the current and to create heat for vaporizing the sodium. As the sodium vaporizes, the colour changes to an orange-yellow and the efficiency rises to about 40 lumens per watt.

At every reversal of the alternating current, the light changes from maximum intensity to zero and back again, so of course there is a slight flicker when operated on low frequencies, but at 60 cycles and other commercial cycles this change takes place so rapidly that it is imperceptible to the human eye.

With a sodium lamp, the maximum luminosity is given off around the lamp in planes perpendicular to the axis of the lamp, with a minimum of intensity at the ends of the lamp, so you have, ready-made for street lighting and highway lighting purposes, an asymmetric distribution. Half of the light output from the bare lamp is already directed onto the street when the lamp is mounted transversely of the highway.

There is no sadder thing than to see the work of a scientific group result in a fine lamp like this and then see it used inefficiently or ineffectively, because more than 50 per cent. of the light will not strike the ground at all unless redirected. Therefore, it becomes essential to use a luminaire that will redirect the rays from the upper half of the lamp to the road surface. By doing this, 4,000 c.p. is secured from a lamp that gives initially only 1,000 c.p.

*Fig. 7—Sodium-vapour lamps at Revere, Mass.—The first commercial installation in America.*

### New Luminaires

Simultaneously with the development of this lamp, the Aluminum Co. of America, with the co-operation of the lighting laboratories, brought out a new reflecting surface—a new aluminum with a new finish, called "Alzak". The principle feature of this new finish is that it is impervious to all atmospheric changes and to all conditions of weather. Thus we have a new tool to work with—one that makes possible a luminaire that can be exposed to the weather—something that we have needed for years. Moreover, the initial reflecting efficiency of "Alzak"—about 82 per cent.—is well maintained throughout its life.

Years ago, in designing the magnetite luminous arc lamp, we found that we could reflect all of the upper light down to a lower plane by the use of two reflectors, each 51 inches in diameter. We got these down to three of 26 inches each in diameter; and finally we got the refractor, and that was a very workable device with a small source of light. But with these new gaseous sources of light, we had to develop something entirely different. Now that we have this new "Alzak" surface to work with, I predict that we will do a great deal with it.

### Time Element Involved

One characteristic of all these gaseous lamps is that a time element is involved in bringing them up to full

*Fig. 8—New highway-lighting luminaire of "Alzak" aluminum, with sodium-vapour lamp.*

brightness. In the case of the sodium lamp, the temperature inside the inner tube must be brought up to 220 deg. cent. in order to vaporize the metallic sodium. In the case of the mercury lamp, the temperature of the arc stream was recently found to be 6,000 deg. cent., and the walls of the inner tube—or, as I prefer to call it, the "burner"—operate at 750 deg. cent. In the mercury lamp, there is a minute quantity of mercury that must all be vaporized before the lamp reaches electrical stability. The lamp starts at 5 amperes and 20 volts, and finally reaches stability at 155 volts and 2.9 amperes, or at about 400 watts. The brilliance of the mercury stream becomes very intense, and it is impossible to look at it with the naked eye.

### Mercury-Vapour Lamp

We find an entirely different spectral condition in the mercury-vapour light source as compared with the sodium lamp. With the mercury-vapour lamp we have blue and yellow and green—in fact there is a superabundance of yellow—and the only thing we find lacking is red, so in the colour correction of such a light source there is much less to do, and it is much less difficult to accomplish, than in the case of sodium. Mercury lamps can be used not only for street lighting, with or without colour correction, but can be used for commercial and industrial lighting. If you wish to approximate daylight, then you simply add white light from an incandescent lamp. Colour correction is needed mainly on account of the effect on the human complexion—in order to show the "blush" of the skin. It is not needed for any utilitarian purpose in street lighting, so far as I can see, other than that in cold climates it assists in providing the heat needed for starting. The diffusing globe of the luminaire blends the incandescent light with that of the mercury lamp in such a manner that the result is a light of very pleasing character.

### Corrected Mercury-Light Installation

About a month ago we made the first commercial street-lighting installation—or, at least, it is the first in America so far as I know—of luminaires using combined mercury and incandescent light. When I say "commercial", I mean a transaction in which the manufacturer entered into a contract with a utility to supply lamps and fixtures, and the utility entered into a contract with the city to supply light from this new source. The city of Lynn contracted with the Lynn Gas & Electric Co., for nine mercury-vapour lamps to be placed around the new post-office. The ornamental luminaires are pendant, mounted about 22 ft. above the ground, and extending 4 ft. over the road surface.

To provide colour correction, 200 watts of incandescent light is used in each luminaire. This installation is operating on a multiple circuit, but even more recently another installation was made in Lynn with the lamps operating in a series circuit and the results are excellent. We get rid of some of the losses in the transformer, and we overcome the starting difficulty in cold weather. It has been noted with these mercury-vapour

lamps that if the temperature goes much below about 15 deg. fahr., difficulty in starting is experienced; but in the series circuit which we have introduced, the ionizing potential available is very satisfactory. Because the mercury vapour is at low pressure, it requires an initial kick of 400 volts to get it going, and at that moment a very low milliampere current goes through it—not enough to kill anybody, but enough to get the lamp started.

In each of these series luminaires at Lynn, we have combined an incandescent lamp with a mercury lamp—2,500 lumens of incandescent with 14,000 lumens of mercury—or a total of 16,500 lumens for each luminaire, taking exactly 530 watts per luminaire. This combination forms a unit which has great commercial promise in the downtown lighting of cities and in the lighting of heavy-traffic thoroughfares.

In the case of the mercury-vapour lamp, it is essential that it be operated in a vertical position because of its high temperature; therefore, the maximum light is given off horizontally, and to utilize it to advantage we must have surfaces that will reflect light—surfaces such as we find in downtown streets — facades of buildings, etc.

Due to the high surface-brilliance of the mercury lamp, a diffusing globe is necessary; whereas in the case of the sodium lamp, because the light comes from the entire inner surface of the glass and not from a concentrated luminous rod, the intrinsic brilliance is low; the sodium lamp can be easily looked at with the naked eye without discomfort. So, while the two lamps are alike in the theoretical aspects of light production, in the matter of utilization and application they seem to be quite dissimilar. Each has its own field. There is no thought at all in our concern of banishing one development for the other. We believe that these two new illuminants will make possible much better street and highway lighting at no greater cost.

# Association of Municipal Electrical Utilities

## Convention Programme

The Winter Convention of the Association of Municipal Electrical Utilities will be held at the Royal York Hotel, Toronto, on January 29th and 30th, 1935. Arrangements regarding the convention programme have advanced very nearly to completion and we are able to give an outline of the main features. The proceedings will be as in the following:

TUESDAY—January 29th, 1935

Morning—

Registration

10.00 o'clock (in Banquet Hall)

Business Session

Receiving reports and recommendations of Committees and discussion and disposition of the same.

Afternoon—

12.30 o'clock (in Concert Hall)

Convention Luncheon

*Address*—"Property and Citizenship", by B. K. Sandwell, Managing Editor, *Saturday Night*, Toronto.

2.30 o'clock (in Banquet Hall).

Election of Officers for 1935. Ballots will be distributed to delegates when registering and up to the opening of this session. These should be marked and deposited in the ballot box, which will be closed immediately after this session opens. The results of the elections will be announced before adjournment for dinner.

*Paper*—By a representative of the Hydro-Electric Power Commission of Ontario, referring to load building, power conditions, etc., followed by discussion.

*Paper*—"Load Building Possibilities in the Domestic Field"—by G. J. Mickler, Sales Department, Hydro-Electric Power Commission of Ontario, followed by discussion.

*Paper*—"Store and Window Lighting", by Geo. G. Cousins, Member and Past Director, Illumination Engineering Society; Testing Engineer-in-Charge, Illumination Laboratory, Hydro-Electric Power Commission of Ontario, followed by discussion.

EVENING—

6.30 o'clock (in Concert Hall)

Convention Dinner

Musical Entertainment

*Address*—"Financing of Hydro", by T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario.

WEDNESDAY—January 30th, 1935

MORNING—

9.30 o'clock (in Banquet Hall)

*Paper*—"Value of Home Lighting to the Public Utility", by Eleanor Potts, Home Lighting Specialist, The Solex Company, Limited, and the T. Eaton Company, Limited, Toronto, followed by discussion.

*Address*—"Better Light — Better Sight", by H. Freeman Barnes, Manager, Lighting Department, General Electric Company, Nela Park, Cleveland, Ohio.

9.30 o'clock (in Hall "C")

Round Table discussion conducted by the Committee on Accounting and Office Administration.

AFTERNOON—

12.30 o'clock (in Concert Hall)

Convention Luncheon

*Address* — "Scientific Certainties and Economic Doubts", by L. A. Hawkins, Executive Engineer, General Electric Research Laboratory, Schenectady, N.Y.

The Electric Club of Toronto, through its President, W. S. Ewens, has accepted an invitation to join the Association at this luncheon.

2.30 o'clock (in Banquet Hall)

*Paper*—"Street and Highway Lighting and Their Load Building Possibilities," by G. F. Mudgett, Member and Immediate Past Chairman, Toronto Section, Illumination Engineering Society; Manager, Lighting Division, Canadian Westinghouse Company, Limited, Hamilton, followed by discussion.

*Short Paper* — "Industrial Load Building", by V. A. McKillop, Public Utilities Commission, London, followed by discussion.

*Short Paper*—"Analysis of Domestic Consumers' Survey Recently Conducted", by D. B. McColl, Manager, Walkerville Hydro-Electric System, followed by discussion.

*Short Paper*—"Expired Meter Record", by J. Ruff, Meter Installer, Brantford Hydro-Electric System, followed by discussion.

The Annual Meeting of the Ontario Municipal Electric Association will also be held at the Royal York Hotel, Toronto, on January 29th and 30th, 1935. Details of the programme of that Association are not available at the time of writing beyond the advice that there will be no joint sessions of the two Associations. It is intended and desired that delegates to the A.M.E.U. Convention and to the O.M.E.A. Annual Meeting, restrict their attendance to meetings of their proper Association during such times as meetings are running concurrently. The Convention luncheons and dinner, referred to in the foregoing A.M.E.U. programme, will be attended by the delegates of both Associations and their guests, as has been the custom at previous Conventions.

* * * *

## Election Ballot

The ballot for the election of officers of the Association of Municipal Electrical Utilities for the year 1935 will show the following names:—

President—O. M. Perry, Windsor (Acclamation).

Vice-President—R. S. Reynolds, Chatham; C. A. Walters, Napanee.

Secretary—S. R. A. Clement, H.E.P.C. of Ont., Toronto (Acclamation).

Treasurer—H. T. Macdonald, H.E.P.C. of Ont., Toronto.
D. J. McAuley, H.E.P.C. of Ont., Toronto.

Directors—(*from the membership at large, three to be elected*)—
E. V. Buchanan, London
D. B. McColl, Walkerville
J. R. McLinden, Owen Sound
J. W. Peart, St. Thomas
O. H. Scott, Belleville
P. B. Yates, St. Catharines

District Directors

Niagara District—
H. F. Shearer, Welland
J. E. Teckoe, Niagara Falls.

Central District—
G. E. Chase, Bowmanville
C. C. Folger, Kingston

Georgian Bay District—
C. E. Brown, Meaford
J. F. Linn, Stayner.

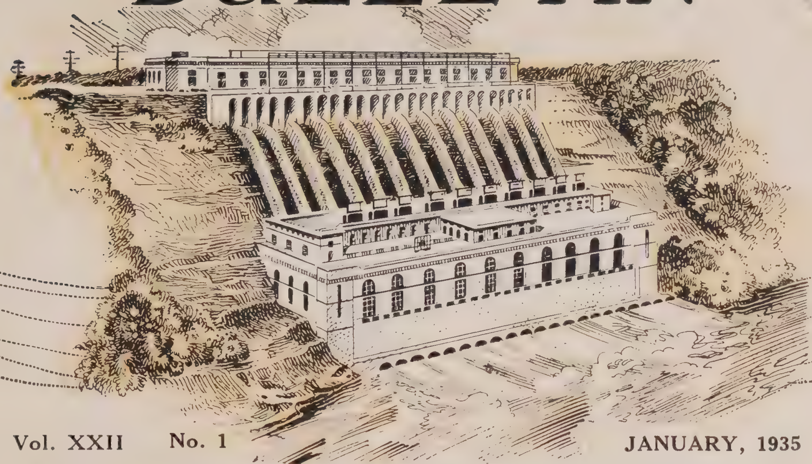
Eastern District—
A. L. Farquharson, Brockville
M. W. Rogers, Carleton Place.

Northern District—
T. W. Brackinreid, Port Arthur (Acclamation).

The ballots will be distributed to the delegates during the morning of the first day of the Convention, January 29th, 1934. Immediately after the opening of the afternoon session on that day the ballot box will be closed and the scrutineers will announce the results of the elections before the adjournment of that session.

# Index to Volume XXI

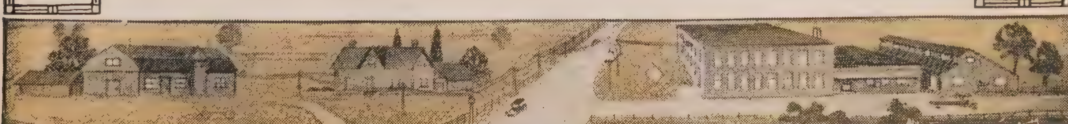
# THE BULLETIN



Vol. XXII No. 1 JANUARY, 1935

## Hydro-Electric Power Commission of Ontario

*Winter conditions, Hanna Chute development.*



# HYDRO MUNICIPALITIES

*(Populations shown are from the last government report excepting where more recent figures have been furnished by the municipalities.)*

## EASTERN SYSTEM

| | |
|---|---|
| Alexandria | 2,370 |
| Apple Hill | 350 |
| Arnprior | 4,072 |
| Athens | 614 |
| Bath | 289 |
| Belleville | 13,899 |
| Bloomfield | 637 |
| Bowmanville | 3,604 |
| Braeside | 550 |
| Brighton | 1,343 |
| Brockville | 9,988 |
| Cardinal | 1,249 |
| Carleton Place | 4,278 |
| Chesterville | 1,000 |
| Cobden | 631 |
| Cobourg | 5,619 |
| Colborne | 965 |
| Deseronto | 1,331 |
| Finch | 365 |
| Hastings | 656 |
| Havelock | 1,142 |
| Kemptville | 1,227 |
| Kingston | 22,368 |
| Lakefield | 1,428 |
| Lanark | 592 |
| Lancaster | 560 |
| Lindsay | 7,161 |
| Madoc | 1,019 |
| Marmora | 1,013 |
| Martintown | 357 |
| Maxville | 742 |
| Millbrook | 714 |
| Napanee | 2,984 |
| Newcastle | 590 |
| Newburgh | 433 |
| Norwood | 756 |
| Omemee | 489 |
| Orono | 700 |
| Oshawa | 25,550 |
| Ottawa | 137,911 |
| Perth | 4,057 |
| Peterboro | 22,798 |
| Picton | 3,146 |
| Port Hope | 4,415 |
| Portsmouth | 679 |
| Prescott | 3,078 |
| Richmond | 367 |
| Russell | 500 |
| Smith's Falls | 7,452 |
| Stirling | 822 |
| Trenton | 5,775 |
| Tweed | 1,206 |
| Warkworth | 500 |
| Wellington | 900 |
| Westport | 635 |
| Whitby | 5,463 |
| Williamsburg | 200 |
| Winchester | 970 |
| Total | 323,499 |

## GEORGIAN BAY SYSTEM

| | |
|---|---|
| Alliston | 1,364 |
| Arthur | 954 |
| Bala | 336 |
| Barrie | 7,166 |
| Beaverton | 988 |
| Beeton | 561 |
| Bradford | 933 |
| Brechin | 255 |
| Cannington | 849 |
| Chatsworth | 251 |
| Chesley | 1,702 |
| Coldwater | 563 |
| Collingwood | 6,027 |
| Cookstown | 635 |
| Creemore | 598 |
| Dundalk | 659 |
| Durham | 1,744 |
| Elmvale | 600 |
| Elmwood | 350 |
| Flesherton | 448 |
| Grand Valley | 590 |
| Gravenhurst | 1,822 |
| Hanover | 3,102 |
| Hepworth | 327 |
| Holstein | 285 |
| Horn ng's Mills | 350 |
| Huntsville | 2,903 |
| Kincardine | 2,511 |
| Kirkfield | 138 |
| Lucknow | 1,115 |
| Markdale | 812 |
| McTier | 450 |
| Meaford | 2,708 |
| Midland | 7,116 |
| Mount Forest | 1,888 |
| Neustadt | 460 |
| Orangeville | 2,772 |
| Owen Sound | 12,778 |
| Paisley | 716 |
| Penetanguishene | 3,767 |
| Port Carling | 439 |
| Port Elgin | 1,203 |
| Port McNicholl | 825 |
| Port Perry | 1,288 |
| Priceville | |
| Ripley | 410 |
| Shelburne | 1,138 |
| Southampton | 1,700 |
| Stayner | 949 |
| Sunderland | 570 |
| Tara | 455 |
| Teeswater | 835 |
| Thornton | 200 |
| Tottenham | 538 |
| Uxbridge | 1,482 |
| Victoria Harbor | 950 |
| Walkerton | 2,280 |
| Waubaushene | 600 |
| Wiarton | 1,880 |
| Windermere | 124 |
| Wingham | 2,229 |
| Woodville | 403 |
| Total | 94,083 |

## NIAGARA SYSTEM

| | |
|---|---|
| Acton | 1,951 |
| Agincourt | 612 |
| Ailsa Craig | 516 |
| Alvinston | 657 |
| Amherstburg | 3,083 |
| Ancaster Twp. | 3,119 |
| Arkona | 383 |
| Aurora | 2,623 |
| Aylmer | 1,996 |
| Ayr | 776 |
| Baden | 710 |
| Beachville | 503 |
| Beamsville | 1,185 |
| Belle River | 715 |
| Blenheim | 1,630 |
| Blyth | 621 |
| Bolton | 609 |
| Bothwell | 575 |
| Brampton | 5,137 |
| Brantford | 32,786 |
| Brantford Twp. | 7,595 |
| Brigden | 400 |
| Bridgeport | 500 |
| Bronte | 400 |
| Brussels | 725 |
| Burford | 700 |
| Burgessville | 300 |
| Burlington | 3,403 |
| Caledonia | 1,456 |
| Campbellville | 200 |
| Cayuga | 661 |
| Chatham | 16,441 |
| Chippawa | 1,222 |
| Clifford | 496 |
| Clinton | 1,911 |
| Comber | 800 |
| Cottam | 333 |

# THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

## "Hydro" at the End of 1934

**By T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario**

PRELIMINARY estimates indicate that the income from light and power in that portion of the Province of Ontario, which derives its electrical energy from the plants and transmission lines owned by the Hydro-Electric Power Commission, was during the year ending October 31st, 1934, $28,313,605, as compared with $26,611,447 in the year ending October 31st, 1933. The increase was quite marked but it was not uniform throughout the four systems into which the Hydro-Electric Power Commission's operations are divided.

The Niagara System, with a total revenue of $22,594,763, contributed about $1,500,000 to the increased earnings; the Georgian Bay System, with a revenue of $1,156,213, had a decrease of $7,000; the Thunder Bay System, with a revenue of $1,381,522, had an increase of only $1,400; while the Eastern Ontario System, with a revenue of $3,181,107, had an increase of $210,000. These figures do not deal with the Northern System which is owned by the Provincial Government.

The lesson to be drawn from them is that business generally in Ontario was far from buoyant in the winter of 1933, and that the industrial pick-up of the early months of 1934 was followed by a slackening of activity in the early Fall.

Power loads seem to have improved more in the case of the heavy industries than in those devoted to the production of goods for household consumption. Speaking generally, for example, towns in which furniture manufacturing provides a large part of the industrial activity had somewhat smaller loads in the Fall of 1934 than in the corresponding period in 1933. Other centres engaged in manufacturing iron and steel in various forms showed a distinct improvement in the quantity of horsepower distributed for industrial purposes.

Industrial recovery on a large scale is of even more importance to the Hydro-Electric Power Commission

## CONTENTS

**Vol. XXII No. 1**

**JANUARY, 1935**



than to most private enterprises, because the Commission, a number of years ago, contracted for the purchase of power on a very large scale from private power corporations operating in the Province of Quebec. It was anticipated that the development of Ontario's industrial plants in the Niagara district would take up these power supplies as speedily as they were available. The result has not been according to expectations.

During the year 1934 the Commission paid for purchase power for the Niagara System $6,876,463. For a considerable amount of this power no profitable use has been found, and further supplies under contract must be paid for during the next two years, until the total cost of purchased power, in 1937, will have reached an annual amount somewhat in excess of $10,000,000. This situation makes it imperative that the Commission shall obtain additional power loads from municipalities and private corporations, wherever they can be found at a profitable price. The attitude of the Commission is that of a merchant with a very considerable quantity of goods on the shelves, for which there is no immediate demand, but who believes basic conditions are becoming steadily, if slowly, better and that ultimately there will be found a profitable sale for all his stock.

Recently in the controversy in the United States, regarding President Roosevelt's proposals for the establishment of power plants under public operation at key positions throughout the Republic, there has been much talk of the financial conditions of the Hydro-Electric Power Commission of Ontario, as the greatest example on the continent of a publicly owned utility. A candidate for the governorship of Minnesota announced in a radio address that the Commission's system had broken down, and that large sums of money would have to be paid by the taxpayers of the Province to enable the Commission to continue the supply of power at figures considerably under cost to the municipalities and to private consumers.

It cannot be too often stated, on behalf of the Commission, that in connection with the four systems previously mentioned there has never been any call for the payment of taxes to meet Hydro deficits, nor will there ever need to be. No private corporation in the power business in America has such a large proportion of liquid assets available to meet temporary adverse conditions as the Hydro-Electric Power Commission of Ontario. The amount at the credit of the Sinking Fund, of Renewals appropriation, and of the Reserve for Contingencies and Obsolescence, totals at the present time $72,713,000. Whatever amount it may be found necessary ultimately to take from the Contingency Fund, to meet operating

losses during the present year, due to the necessity of paying large sums for purchased power, for which there is no demand from the consumer, the position of Hydro, alike in the matter of Sinking Funds and Renewals Reserves, will continue to be exceptionally strong.

Calculations recently made show that as of October 31st, 1933, the last year for which full statistics are as yet available, the Commission used in its light and power business capital totalling—$259,169,000. Of this total $203,845,000 was advanced by the Province of Ontario, while $55,324,000 is in the form of bonds issued directly by the Commission and guaranteed by the Province, both as to principal and interest.

Throughout the years of the depression, the Commission has continued to set up Sinking Funds, which will retire $151,801,000, or 74 per cent. of the capital advanced by the Province by 1960, and $44,310,000 or 80 per cent. of the monies invested in Hydro bonds by the public. It, therefore, appears that by 1960 no less than 75.67 per cent. of the total capital, invested in the power business by the Hydro-Electric Power Commission, will have been returned to the investors. This sum of $196,112,000 represents a rate of accumulation of sinking fund for the retirement of Hydro capital 2¼ times as great as the rate of accumulation for the retirement of all bonds or debentures issued by private Canadian power corporations.

It is not too much to say that financially the Provincial Hydro-Electric Power Commission—like the Insurance Company which first used the comparison—has "the strength of Gibraltar". When business activity again assumes high levels, it will be prepared to sell all the power that industrial Ontario can absorb at prices profitable alike to industry and to the Commission.

* * * *

In the business of supplying electric light and power, and a considerable amount of heating, to some two million two hundred thousand people within the Province of Ontario, the Hydro-Electric Power Commission has been animated by the hope of a steady improvement in the volume of industry. Actual expansion up to the present time, from the low point in the Fall of 1933, has not been so great as was anticipated early in the present year. In the case of some industries, the figures of power consumption indicate a slight recession. This applies more particularly to industries in towns whose industrial life centres around the manufacture of articles for home use. If the power loads tell the truth, there is somewhat less activity in the furniture industry than there was in 1933. Heavy industries, on the other hand, show, generally speaking, a considerable improvement. I am inclined to think the great expansion of gold mining, and the acceleration of preparations for putting new mines into production, has been the greatest factor in bringing about increased power loads during 1934.

A Hamilton industrialist told me, the other day, that one of the most lively departments of his business consisted in the supply of small steel balls, used in the crushing mills in the mines of the North. The expansion

of the Hydro's own business has been in a greater degree due to Northern developments than to those in the well settled parts of the Province. The Commission looks forward with hope and confidence to a steady increase in the volume of ore mined and treated in the Northern gold fields as a means of absorbing a considerable quantity of the surplus power from the Abitibi Canyon.

This large volume of surplus power, which cannot at the moment be profitably absorbed for lighting and power purposes, makes possible a venture on a large scale into the use of electric energy for the production of steam. In seven or eight paper mills, located at various points within the Province from Cornwall in the East to Port Arthur in the West, surplus electric energy, to a total of 200,000 h.p., used under steam boilers is, at the present moment, displacing several thousands of tons of coal weekly. It is estimated that the steam produced by electricity during the winter would have required the use of not less than 250,000 tons of coal under ordinary steam boiler conditions. This new venture is not commercially profitable and will be abandoned whenever the demand for firm power for lighting and manufacturing is increased sufficiently to utilize the energy now devoted to the production of steam. For the present it provides a revenue of somewhat over $1,000,000 yearly, that would be altogether lost, were no use at all found for the energy contracted for from the Power Companies along the Ottawa and St. Lawrence Rivers in the Province of Quebec. To that extent it is found money, and has played a considerable part in reducing the otherwise inevitable deficits in the Niagara System because of the oversupply of power under contract.

As to the long view, the Commission has no doubt that a year or two may elapse before the demand for power overtakes the obligations to accept supply under contract, but eventually the new growth of industry in the Province and the return of normal prosperous times will bring about a balance between power purchased and power supplied to local consumers. I think we may safely say now that there will be no need to increase Hydro rates in any general way to provide the funds for the payment of power the Commission is forced to accept from the Quebec contractors.

An effort has been made to extend the rural power lines in various parts of the Province, by a thorough canvass of the farms lying along the routes and by an offer of free current as a bonus to all persons using electricity on the farms in the operation of washing machines, radios and pressure pumps for domestic sanitary supply. A regulation has also been issued, providing that the maximum first charge in all rural power districts shall not exceed six cents. Many municipalities in the Georgian Bay System, and quite a number in the Eastern Ontario System, had first rates as high as eight cents per kilowatt-hour. It is found that as farmers understand how low the cost of grain grinding operations has been placed under the second and third rates available in rural districts, much interest has been aroused in the use of electricity for this part of the farm chores. The Commission has been asked recently

to make loans for the installation of many grain grinders to farmers engaged in feeding livestock on an extensive scale. The advantage of securing chop by grinding on the premises, instead of by frequent visits to adjacent grinding mills in the villages and towns, becomes increasingly apparent.

The Commission proposes in the coming year to turn the Hydro organization more and more in the direction of Sales effort, and hopes that this will result during 1935 in a steadily increasing load of electric energy devoted to purposes—domestic and industrial—that will be profitable alike to the customer and to the Hydro-Electric Power Commission of Ontario.

# Hydro-Electric Progress in Canada in 1934

(*From Bulletin No. 1784, Dominion Water Power and Hydrometric Bureau, Department of Interior, Ottawa.*)

THE annual review of hydro-electric progress in Canada prepared by the Dominion Water Power and Hydrometric Bureau of the Department of the Interior, discloses that during 1934 no new large water power undertakings were initiated. Work was continued, nevertheless, on several developments already under construction and as a result net new installatons aggregating 214,965 horsepower were brought into operation during the year. This brings the total installation for the Dominion at the end of 1934 to 7,547,035 horsepower.

The recovery in power demand remarked in 1933 gained in momentum during 1934 and the records of electrical output compiled by the Dominion Bureau of Statistics indicate that the total output for 1934 will not only greatly exceed that for 1933 but will have established an all-time record. Output in each month has exceeded that for the corresponding month of 1933 and October established a new record. That this expansion of output is principally due to increased domestic, commercial and industrial demand and not to increased export or use in electric boilers is indicated by October figures, the latest available, which show that after deducting the power exported and that used in electric boilers the ordinary consumption in Canada exceeded that of any previous month, the former high month for similar consumption having been January, 1930. The gain in output has been general but has been most pronounced in the province of Quebec.

The increase in installation during 1934 was due chiefly to the completion of the Rapide Blanc development of the Shawinigan Water and Power Company on the St. Maurice River and to the installation of an additional unit by the Beauharnois Light, Heat and Power Company. Other smaller installations were completed in British

Columbia, Ontario and Nova Scotia. The principal activities in each of the Provinces are described hereunder.

### British Columbia

The mining industry has continued active in British Columbia during 1934 and has increased the demand for power in various parts of the province, particularly in the Bridge River and Barkerville areas in the Cariboo and Sheep Creek district in the Kootenay.

The Bridge River Power Company, Limited, a subsidiary of the British Columbia Power Corporation Limited, completed the Bridge River temporary hydro-electric plant and transmission line to supply electric power to the Bridge River mining district. The plant consists of a 4,600 horsepower unit which was transferred from the lower Jordan River station of the Corporation. A steel penstock 22 inches in diameter and 2,700 feet long feeds the unit, being connected to a steel water stop bulkhead placed in the tunnel about 300 feet inside the Seton portal, the effective head is about 1,020 feet. This tunnel is an essential part of the main Bridge River project and was completed two and a half years ago, it is 14 feet 3 inches in diameter and about 13,000 feet long and affords ample forebay capacity for the temporary plant. Already about 1,365 horsepower is being supplied both for mining and to meet the domestic and commercial requirements of the mining communities.

Pioneer Gold Mines of British Columbia Limited placed a 1,000 horsepower unit in operation in its plant on Hurley River, which is a tributary of Bridge River.

The British Columbia Nickel Mines Limited, added a 365 horsepower unit to its plant on Stulkawhits (Texas) Creek, a tributary of the Fraser River.

British Columbia Pulp and Paper Company, Limited, installed a 150 horsepower water-wheel in the Mill Creek plant for the use of its Woodfibre mill.

### Ontario

In Ontario, the Hydro-Electric Power Commission extended its transmission lines to serve gold mining areas in the northern part of the province notably in the Kirkland Lake and Matachewan districts where power from the Abitibi development was made available and also in the Little Long Lac district where a line was constructed to bring power from the plants on the Nipigon River. Still farther to the northwest the Commission proceeded with the construction of a 1,200 horsepower development at Rat Rapids on the Albany River at the outlet of Lake St. Joseph. It is expected to have this installation completed early in 1935 when power will be transmitted to the Pickle Crow and Central Patricia mining districts to the north of the Albany River.

Another new installation to assist in the mining of gold in the northwestern part of the province was made by St. Anthony Gold Mines Limited on the Sturgeon River below Sturgeon Lake. Here, two units totalling 800 horsepower were installed.

The Town of Almonte added a new unit of 650 horsepower to the largest of its three hydro-electric developments located on the Mississippi River within the town limits.

### Quebec

In Quebec, the increase in hydro-electric installation during the year was 210,000 horsepower, 160,000 horsepower of which was provided by the completion of the Rapide Blanc development on the St. Maurice River and the remainder through the addition of a further unit at Beauharnois.

The Rapide Blanc plant of the Shawinigan Water and Power Company consists of four 40,000 horsepower units operating under a head of 112 feet, the plant has unusually large pondage capacity from which 10,000 second feet, capable of producing about 120,000 horsepower, can be supplied daily per foot drawn down.

The Beauharnois Light, Heat and Power Company continued operations during 1934, including dredging in the canal of approximately 10,000,000 cubic yards, the excavation of 275,000 cubic yards of boulder clay, while the second section of the Coteau Rapids control works and the rock-filled crib submerged weir, 4,500 feet long in the St. Lawrence River above Cedar Rapids were completed. The Company continued the installation of hydraulic and electrical equipment during the year and on October 1st placed in operation an additional 50,000 horsepower, 25 cycle, unit.

### Nova Scotia

In Nova Scotia, the Minas Basin Pulp and Paper Mills, Limited, completed its 4,200 horsepower development on the St. Croix River at Hartville. The development consists of a head dam about 50 feet in height across the St. Croix River above Hartville Station on the Dominion Atlantic Railway; 7,400 feet of conduit, of which 3,500 feet is open canal, and a small power house situated immediately above the main highway crossing of the St. Croix River in the Village of St. Croix. From the intake at the end of the canal to the centre line of the unit, a total distance of 3,925 feet, there is 3,803 feet of 78 inch wood stave pipe, the remaining distance being taken up by steel inlet elbow, surge tank tie and reinforced concrete intake culvert.

Glenburnie Park,
Rubislaw Den North,
Aberdeen.
December 31, 1934

The Hydro-Electric Power
Commission of Ontario.

Dear Sirs:—

Allow me to express my warm thanks for your continued courtesy in sending me your monthly "Bulletin". I read it with interest, and, in particular, have much appreciated Mr. Austen's article in the November issue on "Eye Damage, etc.".

I am now City Treasurer of Aberdeen, and, as such, specially interested in our Electrical Department. Your "Bulletin" presents most interesting standards of comparison.

With compliments and best wishes for 1935,

Yours faithfully,
(*Sgd.*) Ed. W. Watt.

We thank you, Mr. Watt.—*Editor.*

# Electric Steam Generating Stations

**By F. H. Chandler, Assistant Engineer, Electrical Engineering Department, H.E.P.C. of Ont.**

The Commission has installed a number of electric steam boiler installations at various points throughout the Province located close to generating stations, and at locations where practically no additional transmission line costs are necessary. Surplus power is made use of in such installations, displacing at the present time approximately 250,000 tons of coal annually, which was formerly imported for use under ordinary steam boiler conditions. These installations are only possible because of the surplus power which the Commission has on hand at the present time, and power for the production of steam will be curtailed from time to time as this power is required by the municipalities for domestic and commercial uses. It may be, however, that in some of the locations power can be used for the production of steam in the summer months, even though the entire generating capacity may be required for other purposes during the winter peak load. The engineering features in connection with these installations are of considerable interest.

SINCE February 1, 1933, when the Commission's first electric steam generating station of 90,000 kw. capacity was placed in operation at the Ontario Paper Company's plant at Thorold, Ontario, as reported in the April, 1933 issue of The Bulletin, six more installations have been added to the Commission's systems. These seven steam stations have been installed and placed in operation at the locations and in the order shown in the following tabulation:

| *Plant* | *Location* | *System* | *Rating* | *Voltage* |
|---|---|---|---|---|
| Ontario Paper Co. Ltd. . . . . | Thorold | Niagara | 3–30,000 kw. | 6,600 |
| Great Lakes Paper Co. Ltd. | Fort William | Thunder Bay | 2– 8,000 kw. | 2,300 |
| Provincial Paper Ltd. . . . . . | Port Arthur | Thunder Bay | 2–12,000 kw. | 6,600 |
| Provincial Paper Ltd. . . . . . | Thorold | Niagara | 1– 7,500 kw. | 2,300 |
| Interlake Tissue Mills Co. Ltd. . . . . . . . . . . . . | Merritton | Niagara | 1– 7,500 kw. | 2,300 |
| Abitibi Power & Paper Co. Ltd. . . . . . . . . . . . . | Smooth Rock Falls | Northern | 2–25,000 kw. | 6,600 |
| Howard Smith Paper Mills. . | Cornwall | St. Lawrence | 1–20,000 kw. | 6,600 |

It is the purpose of this article to enlarge on some of the characteristics of electric steam generator operation and also set down some of the details of equipment and protection used in the different installations.

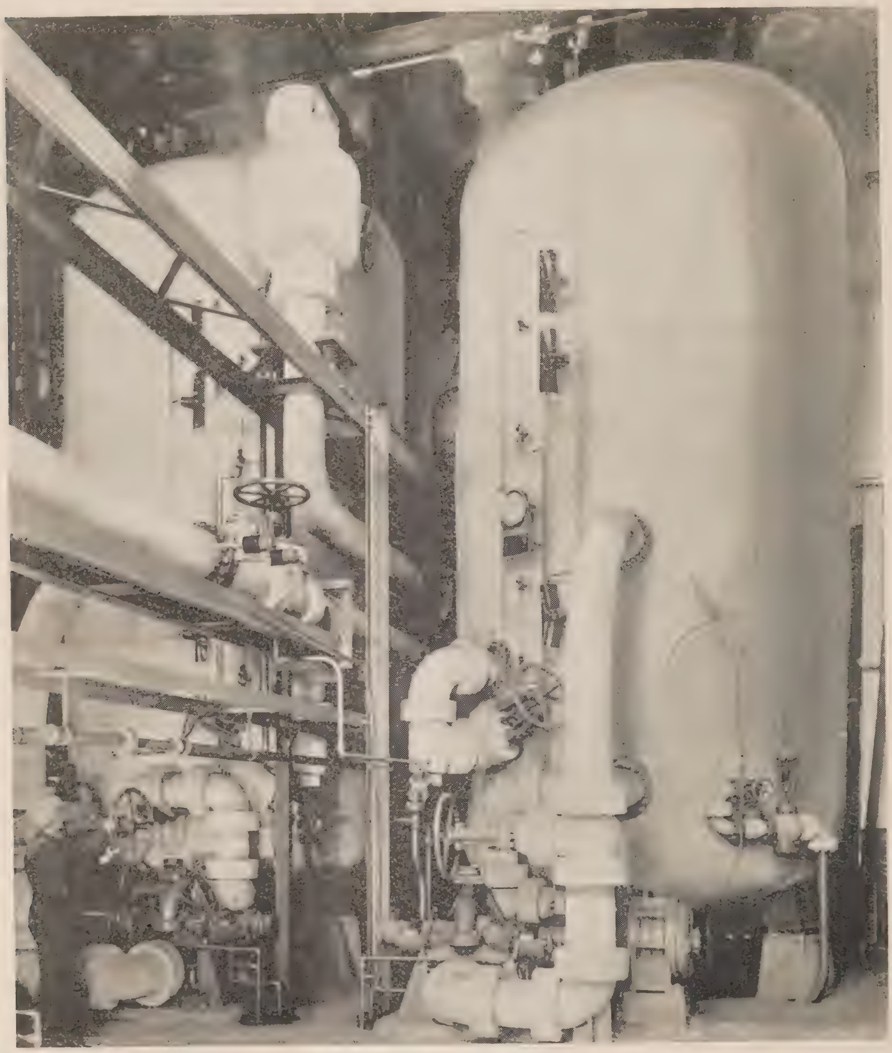
The theoretical conversion efficiency from electricity to heat is 100 per cent. The practical generation of steam electrically, although not so efficient, results fortunately in little energy loss. Radiation with adequate insulation of the shell, say 2 to 2½ inches of some good insulating material, is less than one per cent. The first insulation layer of ½ inch thickness being of the plastic type is found to adhere best by hand throwing on the hot shell, other methods not obtaining a satisfactory bond to the metal. On the larger shells, expansion joints and wire mesh have been added to prevent buckling and breaking away of the insulation from the shell when the generator is passing through the cooling and heating cycles.

The loss by bleeding is the major item. All natural waters contain sulphates and carbonates, which, when they enter the generator in the feed water, do not pass over in the steam. These salts collect in the generator with the result that the electric resistance of the water is decreased and increased current will therefore pass between the electrodes. As the electrodes are usually designed for a current density of less than one ampere square inch, it is necessary to continually remove water from the point in the generator where the greatest concentrates exist so that the quantity of salts remain nearly a fixed quantity and, therefore, the water resistance for which the generator was designed remains nearly constant. This loss of energy due to bleeding may run from three to ten per cent., depending on the characteristics of the raw water used and the percentage of pure condensate returned from the plant process.

Moisture in steam is undesirable. There are no means practicable within an electric steam generator to superheat the steam with the result that separators within the generator or exterior to it in the piping are necessary to remove as much of the moisture as possible at the generator. As a rule it is possible to supply steam with less than one per cent. moisture, but this depends, of course, on the efficiency of the steam separators employed.

Some studies have been made by the Commission's engineers as to the best methods of superheating steam, which of course is only possible by heating the steam in a separate chamber away from the generating unit. At this date no installations have been made by the Commission, although it is understood that it is being done in Germany. There are two methods possible either by electric heat resistance elements in the steam, or by means of electrically generated high pressure steam with resulting higher temperature, the increased heat of which can be imparted to the plant steam in a heat exchanger.

The largest diameter of generator which can be fabricated at this date is eleven feet six inches, this size being set by the largest diameter heads available. This is the diameter of the shells used at the Ontario Paper Company at Thorold and at the Abitibi



*Two of three, 30,000 kw., 3 phase, 25 cycle, 6,600 volt steam generators installed at Ontario Paper Company plant at Thorold. Maximum operating pressure 200 pounds per square inch.*

Power and Paper Company's plant at Smooth Rock Falls west of Cochrane.

The Commission has purchased and installed three different makes of generators, each manufacturer having special features which it is claimed have advantages in steam generation.

The Canadian General Electric Company generators used in three of the plants are of the two compartment recirculating type, the water being pumped from the lower storage compartment to the upper steam generating basket. The manufacturer claims

the rapid movement of water past the electrodes assists the steam bubbles in getting to the surface and smoother operation of the unit.

The Dominion Engineering Company generators used at the Great Lakes Paper Company at Fort William are of the single shell type with the electrode nest suspended in the water. No pump for water recirculation is used, which arrangement the manufacturer claims makes for simplicity of operation.

The "Penzold" generator is a German development but is manufactured in Canada by E. Leonard and Sons, London. This type has been installed at three plants. This generator is of totally different internal design, the water path resistance between electrodes being restricted by ceramic or porcelain stacks, which the designer claims gives positive assurance of equal phase loading, and that little or no energy is converted at the electrode. These stacks are made up of a number of porcelain discs 1⅜ inches thick, this construction being used to prevent breakage due to the varying thermal heat over the length of the stack.

By this means the manufacturer claims the generator can be readily designed for a considerable range of electrical resistance of feed waters, the resistance paths being varied by the number and spacing of the stacks.

The April, 1933 issue of THE BULLETIN gives a very complete article on the 90,000 kilowatt installation at the Ontario Paper Company's plant at Thorold.

The six other plants installed bythe Commission since the station at the Ontario Paper Company was placed in operation are herein described.

* * * *

### HOWARD SMITH CORNWALL (STEAM) T.S.

In Service, Aug. 19, 1934

The station at the Howard Smith Paper Mills Ltd., in Cornwall is rated at 20,000 kilowatts, which is an equivalent steam rating of approximately 60,000 pounds of steam per hour.

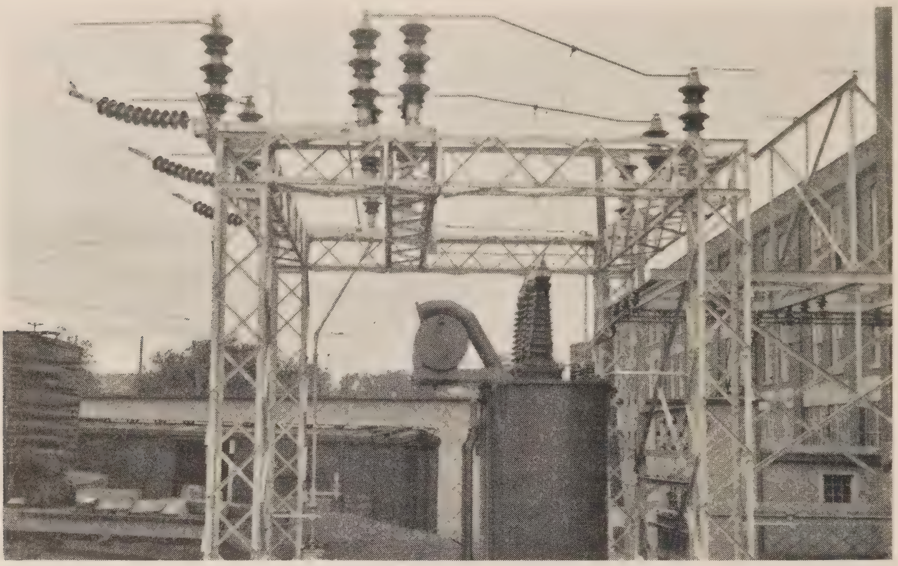
The fact that two 110-kv. circuit breakers were available at Cornwall transformer station made it feasible and economical to bring the Ottawa-Cornwall line into the Cornwall station, and to feed the line to Howard Smith Paper Mills from this bus through the second breaker. A new 110-kv. circuit, two and a half miles long, was erected from the Cornwall transformer station to the Howard Smith Paper Mills.

As the 110-kv. circuit breakers, line entrances and disconnecting switches were suitable for this purpose, it was only necessary to carry out minor relay changes at the Cornwall transformer station to prepare for the new load.

*Step-down Station*

The 105/6.6 kv. step-down station at the Howard Smith plant was located adjacent to the Company's boiler house, and the electric steam generator was placed just inside the building, making possible short 6.6 kv. leads.

Having a 110 kv. circuit breaker at Cornwall transformer station on the short line feeding the station, it was not considered necessary to provide a high voltage breaker at the step-down



*Switching structure and 20,000 kv-a. transformer at the Howard Smith Paper Mills plant at Cornwall.*

station. However, the possibility of future additional customers on this line made it advisable to supply some means of disconnecting the station should trouble therein occur.

To do this an automatic grounding device and spring-operated, air-break switch was provided, so arranged that relays would trip the grounding device causing a short circuit which would open the breaker at Cornwall transformer station, and following which the spring-operated, air-break switch would open, clearing the station from the line. Service could then be restored immediately to remaining customers by closing the breaker at Cornwall transformer station.

Lightning protection is provided by spark-over gaps co-ordinated with the transformer insulation.

The automatic air-break switch and the above mentioned gaps were mounted above the transformer on a steel structure, an extension of which also carried the low voltage switching equipment. The transformer was arranged for Y-delta operation, with its high voltage neutral solidly grounded.

*L.V. Switching Equipment*

The 6.6 kv. switching equipment consisted principally of a 2,500-ampere, electrically-operated, oil circuit breaker, disconnecting switches and the necessary 4 by ¼ inch copper bar conductors to carry the current. Three double secondary potential transformers were installed to provide potential for the relay equipment and the necessary 2,500-ampere current transformers were of the bushing type mounted in the circuit breaker.

In order to provide against strain on equipment resulting from movement of the structure due to line strain

or unequal settlement of foundations, flexible joints were provided between the transformer and circuit breaker terminals and the heavy conductors mounted on the structure. These were made of many thin sheets of copper bent in a semi-circle with the straight ends pressed together and soldered into a solid bar. Inside the boiler room expansion of the steam generator was allowed for by spring suspension of the bus immediately above the generator.

The switchboard controlling the installation was located adjacent to the new steam generator on a gallery which provided convenient access to the steam and water gauges as well. On it were mounted the usual instruments and relays with the controllers for the air-break switch and the oil circuit breaker. The air-break switch controller is interlocked with the circuit breaker to prevent opening except when load is off.

*Electric Steam Generator*

The electric steam generator, rated at 20,000 kw. operating at 6,600 volts and at a working steam pressure of 185 pounds (gauge), is of the Penzold type manufactured by E. Leonard & Sons, London, Ontario. No circulating water pump is required for this type, the depth of immersion being controlled by adjustment of the feed water and bleed valves.

The use of a powdered fuel on an adjoining fuel-fired boiler made it necessary in this installation to protect the instruments and relays on the switchboard from dust. This was done by enclosing the switchboard in a wood and glass partition, which also served as a telephone booth.

* * * *

## Great Lakes Paper Co., (Steam) T.S.

In Service October 1, 1933

This plant is located in the Township of Neebing on the outskirts of Fort William, Ontario.

It was decided by arrangement with the customer to utilize for the supply of power to the electric steam generator, the 110 kv. equipment and power transformers in the original transformer station for the mill, which station was erected in 1924 and supplemented by a new station of 40,000 kv-a. capacity (ultimate) in 1929. The supply is over a 110 kv. line from the bus of the Commission's Port Arthur transformer station.

To connect the h.v. of this original transformer station with the 110 kv. line supplying the new transformer station it was necessary to extend the transmission line approximately 1,300 ft. across the mill property. Wood poles and two steel towers were used for the extension. The material for this line extension was supplied by the customer and the labour by Commission.

*H.V. Equipment and Transformers*

It was necessary for the customer to change the 110 kv. entrance bushings in the original substation from the north to east side of the station, as the 110 kv. connections were required at this side. With the exception of the foregoing no alterations were necessary to the original 110 kv. installation in the Company's station.

The transformer bank consists of three Canadian Westinghouse Co., 4,000 kv-a., 1 phase, o.i.w.c., 60 cycle, 63,500/2,300 volt transformers connected Y-delta and controlled on the

h.v. side by a Canadian Westinghouse Co. type "G2F", 110 kv., electrically operated, oil circuit breaker.

All the existing 110 kv. equipment and the transformers were overhauled by the customer and tested out before being placed in service.

The 2,300 volt connections in the station from and including part of the transformer delta-bus and including the main bus were installed by the Commission in the customer's station. These connections consist of four ¼ by 4 inch copper bars per phase mounted vertically with ¼ inch spaces between the bars. One and one-half tons of copper bar were required for these connections. The connections are designed for 4,000 amperes per phase continuous at 30 deg. cent. rise and for a short circuit stress of 100 lb. per foot length. No porcelain insulators are used to support the bar copper-connections. The 4 bars of each phase are supported on a 1¼ in. pipe erected horizontally over which is pressed a "micarta" insulating sleeve of approximately 20,000 volts puncture strength. The copper bars are clamped to the "micarta" insulating sleeve by means of special bronze fittings using "U" bolts to clamp around the insulating sleeve and steel bolts to clamp the bus bars. Clamped-connections were used throughout.

For each of the two 2,300 v. feeders to the electric steam generators, two Canadian General Electric Co., type F.KR55-28, 15 kv., 1,200 ampere electrically operated, oil circuit breakers were supplied by the customer and connected in parallel. Each feeder can be isolated from the 2,300 v. bus by means of 3,000 ampere button contact disconnecting switches mounted on 2 in. ebony asbestos panels.

Each of the two 2,300 v. feeders between the transformer station and the electric steam generator in the steam plant are run overhead using two 1,250,000 cir. mils cables per phase strained between the two buildings. Spacers are located every 12 feet to prevent the phases coming in contact under short circuit. At the steam plant the two 1,250,000 cir. mils cables per phase are supported by insulators and suitable galvanized brackets on the outside wall as far as the entrance bushings. At the rectangular porcelain entrance bushings the 1,250,000 cir. mils cables are connected to two ¼ by 4 inch copper bars per phase running down to the terminals of the electric steam generators.

Solderless connectors and Everdur bolts have been used for all outdoor connections.

### *Station Service*

The service bank for this installation consists of three 25 kv-a., 2,300/575 v, 1 phase, 60 cycle transformers which are located outside the transformer station and supplied from the main 2,300 v. bus through high rupturing capacity fuses.

These transformers supply the auxiliary feed water pumps for the electric steam generators located in the steam plant and also heaters in the transformer station.

### *Electrical Control and Relay Protection*

The remote control of the two paralleled 2,300 v. breakers for each electric steam generator is mounted on an ebony asbestos panel located

close to the electric steam generators in the steam plant.

Both 2,300 v. breakers on each feeder are closed or tripped simultaneously from the control panels.

On each panel 3 indicating ammeters are mounted for the operators' guidance. There is also one indicating voltmeter and voltmeter switch located on one panel. These meters are supplied from the instrument transformers located in the 2,300 v. connections in the transformer station. Relay protection is provided to protect the apparatus on each feeder in case of a short circuit or ground developing in the electric steam generator or 2,300 v. connections between the transformer station and steam plant. This protection will trip the feeder breakers controlling the feeder instantaneously.

Protection is also provided in case of a phase to ground fault developing on the 2,300 v. connections between the power transformers and the feeder oil circuit breakers. The system operates on totalized unbalanced current supplied by the electric steam generators to a ground fault.

Unbalanced voltage, which may be due to a low resistance phase to ground fault anywhere on the 2,300 v. connections of the station, is also guarded against. The relay system is set above the permissible unbalance of the electric steam generators. The voltage relays are connected in this case across the open corner delta secondaries of the 2,300 v. potential transformer and operate on residual voltage due to unbalance in voltage of the 2,300 v. system. This trips the 110 kv. breaker through a timing relay.

A similar protective system is also provided for high resistance ground faults on the 2,300 v. systems or heavy unbalance of the electric steam generators or open potential secondary-circuit. This system sounds an alarm as a warning to the operator.

Overload protection on the transformer bank or short circuit on the 110 kv. or 2,300 v. connections is also provided. This relay system is set at about twice the transformer bank rating. A timing relay is used in conjunction with this system which in turn trips the 110 kv. breaker. Low voltage relays are also provided to trip the feeder breakers in case of loss of voltage due to system trouble.

*Totalizing Metering*

The total load taken by the two electric steam generators is recorded on a graphic kw. meter and an indicating watthour meter, these instruments being supplied from a set of 5,000/5 ampere, through type current transformers and 2,300/115 v. potential transformers in the 2,300 v. main connections. On account of the high potential obtainable across the secondaries of the 5,000/5 ampere current transformers if accidentally open circuited a suitable reactance coil has been placed across each secondary directly at the transformer.

*Electric Steam Generators*

Two 8,000 kw., 2,300 v., electric steam generators manufactured by Dominion Engineering Works, each nominally rated at 25,000 pounds of steam per hour, have been provided and operate at 135 pounds steam pressure (gauge). They are of the single tank type and are fitted with surge tank automatic pressure control using

Mason-Neilan control valves. These generators supply steam solely for plant digesters, in which sulphite pulp is prepared.

*Grounding System*

The grounding system consists mainly of a 250,000 cir. mils cable forming a loop from the city water mains in the basement of the steam plant, to the tanks of the electric steam generators through eight ground rods driven into the ground between the buildings, to the 2,300 v. structure, h.v. breaker and the three power transformers in the transformer station. Small conductors are tapped off this main ground loop system at various points to ground small apparatus.

* * * *

## ABITIBI SMOOTH ROCK FALLS (STEAM) T.S. AT SMOOTH ROCK FALLS, ONTARIO

In Service August 1, 1934

### ELECTRICAL EQUIPMENT

Lines—This station is supplied with electrical energy over a double circuit 132,000 volt steel tower line connected at Hunta to lines from the Canyon generating station.

*Step-down Station*

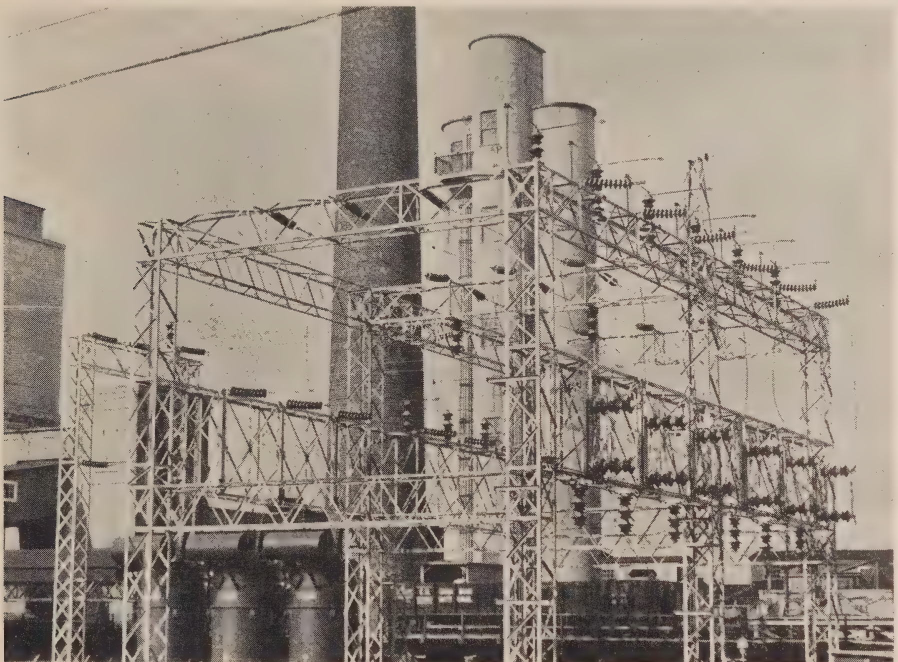
The electrical equipment consists of one bank of three 13,000 kv-a., outdoor-type, single phase, water-cooled transformers with 132 and 6.6 kv. outdoor switching equipment and two outdoor 6.6 kv. feeder equipments for controlling the electrical steam generators. The necessary steel structures, foundations and auxiliary service equipment are provided.

The high voltage outdoor structure consists of two galvanized steel structures, one structure of 2 bays, 39 feet square by 47 feet high for supporting the 132 kv. main bus, the two incoming line, three-pole, gang-operated disconnecting switches and one end of the transformer bus, the other structure (two girders and two towers) 48 feet high by 24 feet wide for supporting one end of the transformer 132 kv. bus and part of the 6.6 kv. main bus, two sets of 132 kv. co-ordinating gaps and one ground switch (closed electrically and opened by hand operation) are also mounted on the top girders of this structure. The ground switch is closed by push-button control and automatically by relays and grounds one phase of the 132 kv. bus. This ground causes the 132 kv. line oil breaker in Canyon generating station to open, cutting off this station in any emergency. Two push buttons are located at strategic points for this emergency. The two sets of co-ordinating gaps are to provide protection to the high voltage equipment from lightning.

The three transformers, installed in this station, are of Canadian Westinghouse make, rated at 13,000 kv-a., single-phase, 25-cycle, 69,300/6,600 volt, oil-insulated, water-cooled and outdoor-type.

*Low Voltage Structure and Equipment*

The low voltage outdoor structure, consisting of one horizontal girder supported on towers and two steel structure bays (10 feet 4 inches by 8 feet by 19 feet high) with extension to the building, supports the outdoor 6.6 kv. main bus with the 6.6 kv. leads to the power transformer, the 6.6 kv. metering and relay instrument transformers, and the switching equipment



*Switching structure and transformer bank at the Smooth Rock Falls plant of the Abitibi Power and Paper Company.*

for two 6.6 kv. steam generator feeder equipments to the existing wall of the company's boiler house. The indoor equipment for the two steam generator feeder equipments is mounted on pipe structures.

The 6.6 kv. main busses carrying approximately 3,600 amperes per phase at full load, consist of two 6-inch aluminum channel bars per phase (in box construction) and the connections from this bus to the power transformers and the electric steam generators consist of four 4 by ¼ inch copper bars per phase, special soldered aluminum to copper connectors being used for connecting same to the main bus. Special busses consisting of two 4 by ¼ inch copper bars per phase were installed on the heads of each of the electric steam generators for making connections to the six electrodes. Supporting brackets were welded to the heads. Heavy duty petticoat insulators are used to support the main 6.6 kv. bus and the connections to the power transformers and electric steam generators, and heavy duty corrugated insulators to support the smaller capacity busses on the electric steam generator covers. The low voltage bus and oil circuit breakers are roofed with acid proof corrugated material to offset the effects of sulphite pulp which contains a high percentage of sulphurous acid. Some pulp is discharged to atmosphere when the digesters are blown.

Each indoor electric steam generator is equipped with three 15 kv.,

3,000 ampere, high pressure contact disconnecting switches and one 15 kv., 3,000 ampere, 3p.s.t. motor-operated, automatic oil circuit breaker all of outdoor-type.

*Relay System*

The relay protection is designed to give instantaneous clearance of any faults on the 6.6 kv. system. It consists of:

1. Ratio differential protection on the transformer bank zone, tripping both steam generator breakers and closing the h.v. ground switch.

2. Excess current protection on the transformer bank, which trips both steam generator breakers and closes the h.v. ground switch.

3. Current differential protection for grounds on the 6.6 kv. bus, tripping both steam generator breakers, as the steam generators are a source of ground current.

4. Residual voltage ground detector, which trips steam generator breakers after a time delay, also gives an alarm in case of a light ground.

5. Impedance distance protection on each steam generator feeder for short circuits and grounds on feeder or generator, tripping respective steam generator breaker.

6. Station no voltage protection. This trips both steam generator breakers in case of a power failure to the station.

7. No voltage protection on circulating pump motors, tripping respective steam generator breaker.

*Service Equipment*

The station service equipment consists of one 15 kv., 575/115-230-volt, 1 phase, 60-cycle transformer, supplying the 110 and 220 volt control equipment for the electrical operation of the 6.6 kv. oil breakers, the outdoor lighting system, the heating system for the power transformers and the oil breakers, and the trickle charger for charging the 12-cell, 60-ampere-hour storage battery which supplies the 24-volt d.c. service for tripping the oil breakers and energizing the indicating lamps for same.

*Steam Generators*

Two 25,000 kw. 6,600-volt electric steam generators are installed and are of Canadian General Electric manufacture. A departure from standard design was agreed on for this installation by directing the ingoing feed water to the generator into the recirculating pump suction. This was arranged so that the incoming feed water at 200 deg. fahr. would have no effect on the temperature of the water in the lower chamber which is at approximately 350 deg. fahr., and this water in the lower chamber would be available for flashing into steam if the pressure dropped at the time of sudden increase in steam demand.

These generators are the same diameter as those at the Ontario Paper plant but are 3 feet 6 inches higher. This increased height is to allow for flash steam output with the feed water shut off, over the time of increased demand, which materially assists in smoothing out the kilowatt demand from the system.

* * * *

### Provincial Paper Co., Port Arthur (Steam) T.S.

In Service November 13, 1933

#### Electrical Equipment

*Line*

This station is supplied with elec-

trical energy over one 110 kv. line from Port Arthur transformer station.

*Step-down Station*

The electrical equipment consists of two 12,000 kv-a., 3-phase, o.i.w.c., 60-cycle, outdoor type transformers of Canadian Westinghouse make with 110 and 6.6 kv. outdoor switching and two 6.6 kv. outdoor feeder equipments, also structures, foundations and auxiliary equipment.

*High Voltage Structure*

The high voltage structure consists of two galvanized steel towers each 57 feet 6 inches high, spaced 60 feet apart and connected by two box girders. This structure supports the one incoming line, one 110 kv. bus and the gang-operated air break switches. Each of these switches is supplied with a grounding blade which is closed automatically by relays grounding one phase of the 110 kv. bus and line. This will cause the 110 kv. line breaker at Port Arthur transformer station to open, thereby cutting off energy to this station.

*Low Voltage Structure*

The low voltage structure is made up of two-inch and 1¼-inch pipe work. It is 33 feet long, 6 feet wide and 16 feet high. This structure supports the main 6.6 kv. bus and switching for the two 6.6 kv. feeders. The bus is constructed of two 4 by ¼ inch copper bars per phase, as are the connections to the low voltage terminals of the transformers and the steam generators. The disconnecting switches are rated at 2,000 amperes, while the oil breaker on each feeder is rated at 1,600 amperes

*Relay Protection*

The relay protection is designed to clear instantaneously 6,600 volt grounds and short circuits on the steam generator feeders. It consists of the following features:

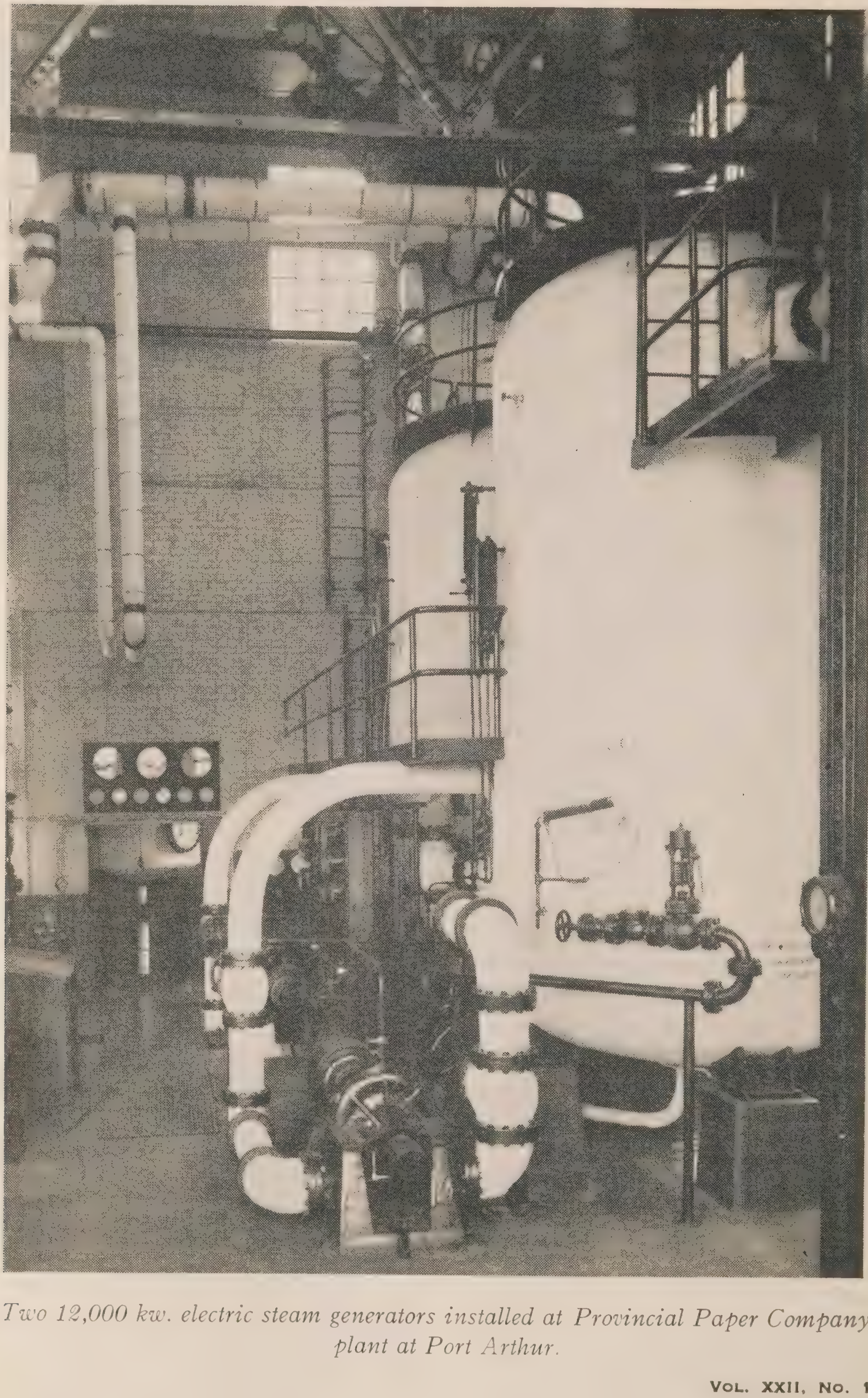
1. A residual voltage protection for 6,600 volt grounds which trips the feeder breakers instantaneously for heavy grounds and operates an alarm for light grounds.

2. An excess current protection on the transformer bank which trips the feeder breakers instantaneously and after a time delay closes the h.v. ground switch. The latter feature is used to clear short circuits on the transformer bank h.v. or l.v. covering by tripping the line breaker at Port Arthur transformer station on the ground current created by the closure of the h.v. ground switch.

3. A no voltage protection on the circulating pump motor circuits which trips the feeder breakers in case the supply fails.

*Service Equipment*

Electrical energy for the station service equipment is obtained from the customer at 550 volts, which voltage is used for the circulating pumps of both steam generators. One 15 kv-a., one-phase, 575/230-115 volt service transformer is installed to step down from 500 to 110 volts. This latter voltage is used for outdoor lighting, heaters for the oil breakers and transformer piping, also for supplying a.c. voltage to a trickle charger which charges a 24 volt battery. This battery supplies d.c. current as the tripping source for the two 6.6 kv. oil breakers.



*Two 12,000 kw. electric steam generators installed at Provincial Paper Company plant at Port Arthur.*

*Metering Equipment*

The station load is metered on the low voltage side of the transformer banks. The equipment consists of four 1,600/5 ampere current transformers, six 6,600/110-110 volt potential transformers, one recording wattmeter and two watthour meters.

*Switchboard*

The switchboard consists of four panels, two of which are located near the steam generators. On these two panels are installed indicating ammeters, voltmeters, temperature indicators and controllers for the two feeder oil breakers. The other two panels are located in an adjoining room and support the recording meters and relays.

*Electric Steam Generators*

The two electric steam generators are each rated at 12,000 kilowatts (approximately 36,000 pounds of steam per hour) and operate at 185 pounds gauge pressure. They are of Canadian General Electric make and are of the two chamber type, 8 feet in diameter, and supply steam for the mill process. Steam separators and main steam stop valves were also provided.

* * * *

PROVINCIAL PAPER CO. (STEAM) DISTRIBUTING STATION AT THOROLD
In Service January 1, 1934

*H.V. Structure and Equipment*

The electrical equipment for this steam generating station consists of an outdoor, four-pole wood structure situated on the bank of the old Welland Canal and includes a Canadian Westinghouse Company type CH1, motor-operated, oil breaker and an English Electric Company 7,500 kv-a. 3-phase, 25-cycle, 13,200-11,880/2300 volt, o.i.w.c., outdoor transformer, together with the necessary 12 kv. switching equipment.

Two 1,000,000 cir. mils cables per phase carry the low voltage current from the pole structure to the building at which point connections are made to the two 4 by ¼ inch copper bus bars which are supported on pipe frame work suspended from the roof beams of the steam generator room. Connections between the bus and steam generator electrodes are made with two 4 by ¼ inch bars.

*Metering Equipment*

The metering of this station is on the low voltage side and the equipment consists of two Ferranti type GT7, 2,500/5 ampere current transformers, three Canadian General Electric Company type E2-Y, 2,200/110 volt potential transformers and a Canadian Westinghouse Company type "G", graphic recording wattmeter and a type "C" polyphase watthour meter.

*Switchboard*

The switchboard consists of one panel on which is mounted the recording wattmeter and watthour meter, the ammeters and voltmeter supplied by the Ferranti Electric Limited, a Leeds and Northrup temperature indicator for the transformer and relays manufactured by the Canadian Westinghouse Company and Cansfield Electrical Works.

A 24 volt d.c. Hart battery and a a Union switch signal trickle charger supply d.c. current as the tripping source for the 12 kv. oil break

*Steam Generator*

A Penzold type generator fabricated by E. Leonard & Sons and rated at 7,500 kw., 2,300 volts was installed at this station.

* * * *

Interlake Tissue Mills (Steam) Distributing Station
In Service January 1, 1934

This station is located on the bank of old Welland Canal at the Interlake Tissue Mills Company's plant, Merritton, and is supplied from a 13.2 kv. single circuit line from Thorold transformer station.

The electrical equipment consists of one outdoor 13.2 kv. incoming line switching equipment, one 7,500 kv-a., 3-phase, 25-cycle, 13,200-11,800/2,300 volt, o.i.w.c. outdoor transformer of English Electric Company manufacture, one 2.3 kv. generator feeder switching equipment, and one 7,500 kw., 2,300 volt indoor-type electric steam generator.

The 13.2 kv. line switching equipment consists of three 800 ampere, s.p.s.t., disconnecting switches, three pellet type single pole lightning arresters, one 400 ampere motor-operated outdoor oil circuit breaker with the necessary pole structure and foundations for the installation of same.

The 2.3 kv. generator feeder equipment consists of two 4 by ¼ inch copper bars, supported outdoors on petticoat insulators and indoors on heavy corrugated insulator with connections from this bus to the secondary bushings of the power transformer, the metering current and potential transformers and to the electric steam generator.

The two switchboard panels for the control of the equipment and the measurement of the load are installed in this station, the panel with the indicating meters (including temperature), watthour meter and the oil breaker controllers being located in the electric steam generator room, and the second panel with the relays and the recording watt-meter being located in the company's station service room.

The relay protection is designed to clear this station from service when any trouble develops in the high or low voltage equipment and indicates by bell alarm if the low voltage is either partially or fully grounded.

*Electric Steam Generator*

A generator identical to that used at the Provincial Paper Steam Station Thorold, was installed in this plant.

# Tests of Fuse Switches

**By R. E. Jones, Assistant Engineer, Distribution Section Electrical Engineering Department, H.E.P.C. of Ont.**

IN the past two years there have been several new fuse switches brought out, all of the drop-out type. The drop-out switch has become very popular due principally to the indicating feature. Another point of equal value is the mechanical opening of the circuit which eliminates the burning of fuse tubes by arcing in cases of light overload.

To determine the most suitable switch for use on the 9,000 miles of rural line the Distribution Section in co-operation with the Operating Department and the Laboratory conducted a test on 12 different switches of 5 manufacturers.

The test was divided into five parts:

(*a*) Short circuit—3,000 amperes r.m.s.
(*b*) Heat run.
(*c*) Radio interference.
(*d*) Flashover.
(*e*) Inspection mounted on cross-arm by engineering staff.

For the short circuit test arrangements were made for the use of generators in the Toronto Power Generating Station at Niagara Falls.

At the generating station 4—8,000 kv-a., 12,500 volt, 25 cycle, generators were operated in parallel with the voltage reduced to 5,400. There

*Set up for Tests, Disconnects are located on pole in background.*

*Above photograph shows some of those present at the tests. Among them are the following Utility engineers:—C. B. Downer, West Penn Electric Co., J. R. North, Commonwealth and Southern Corp., L. M. Stinchcomb, Consumers' Power Co., Mr. Smith of Niagara Hudson Corp., and C. M. Steeves, Canadian General and Finance Company.*

were series reactors in the leads from each generator. From the generating station 2,000 feet of cable went to the transformer station. At the latter point was an oil breaker controlled by overload relays located near the generators. These breakers were also arranged for operation by the oscillograph operator at the transformer station. He was located at a window with a full view of the tests. A short length of cable carried the circuit out of the station to an overhead line. At the end of 2 spans this line was tapped through a pair of stick-operated disconnects to a span of No. 00 copper, which latter terminated in the switch under test.

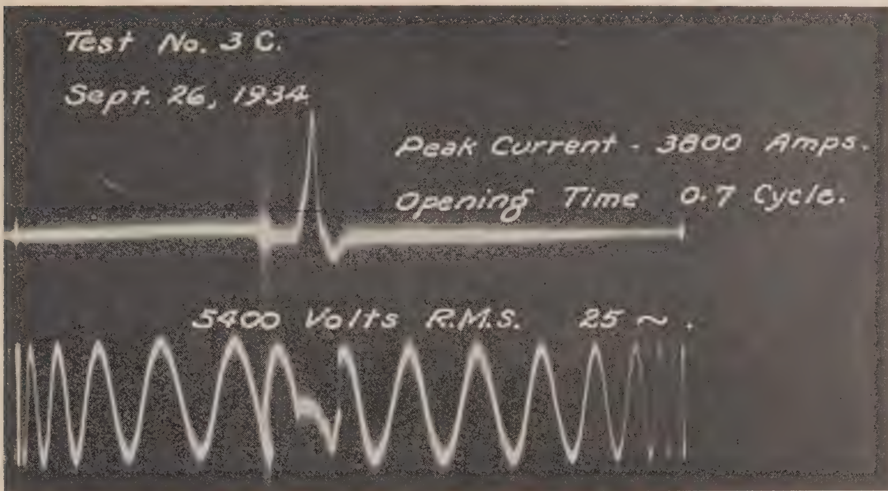
For each test the oscillograph operator closed the oil breaker after receiving word by telephone that the pole disconnects were closed.

Preliminary tests with an ammeter and no fuse showed a short circuit current of 3,000 amperes r.m.s. at 5,400 volts. Oscillograms taken at the same time gave a peak current of 4,700 amperes, due to the peaked shape of the wave. The power-factor was less than 10 per cent. The relays were set to trip the breaker in 33 cycles.

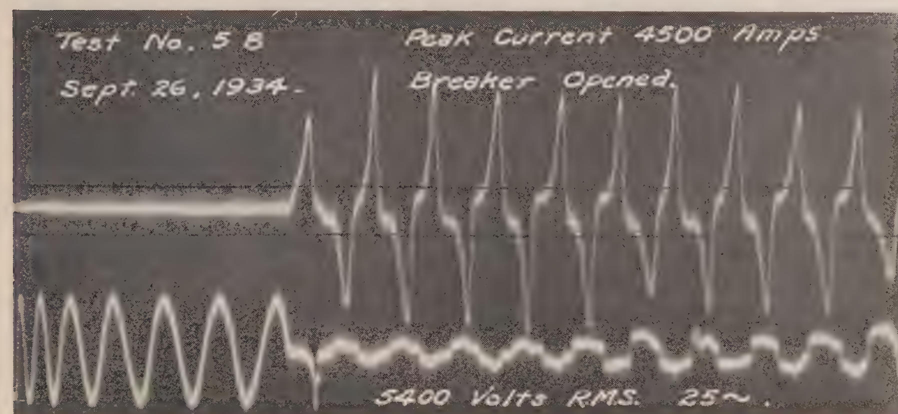
To simulate conditions on a rural line where the primary neutral is grounded at each installation as are the switch frames, the bottom terminal of each switch was tied to the frame.

Some 150 ampere enclosed porcelain box cutouts were also included in the short circuit test.

With each open switch, as far as possible, 10 fuses were used in sizes of 10 and 50 amperes. The first 8




*50 Ampere fuse. End of tube shattered below lower casting.*




*50 Ampere fuse. Tube shattered. Arced across contacts. Station breaker opened*

fuses were of a tension type standardized for use on the Commission's system. These were followed by 4 fuses made by the manufacturer of the switch under test. For these latter 4 fuses a fresh cartridge was installed.

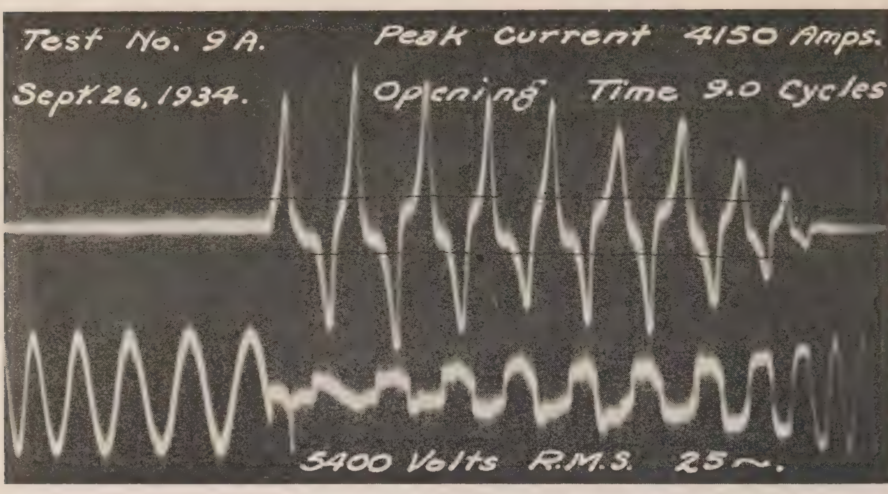
One visiting engineer was able to obtain very good moving pictures of the tests.

In these tests 134 fuses were blown in two working days. An oscillogram was obtained of each shot.

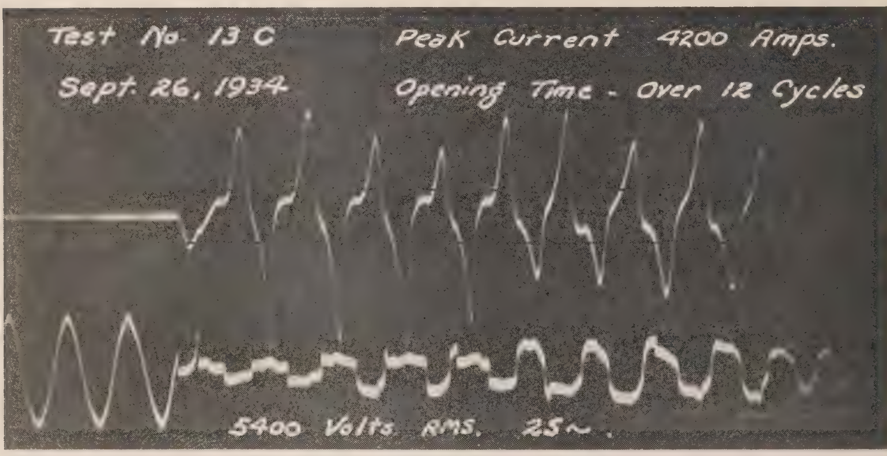
While it was evident that the short circuit current varied greatly, depending partly on the point of the wave at which the breaker closed, there were not enough tests with the same switch and fuse to enable definite conclusions to be formed on this point.

The following points were noted in these tests:

The fuse cartridge should be heavy with a large bore. The necessity for a small bore for clearing the arc in




*50 Ampere fuse. Arced and cleared.*



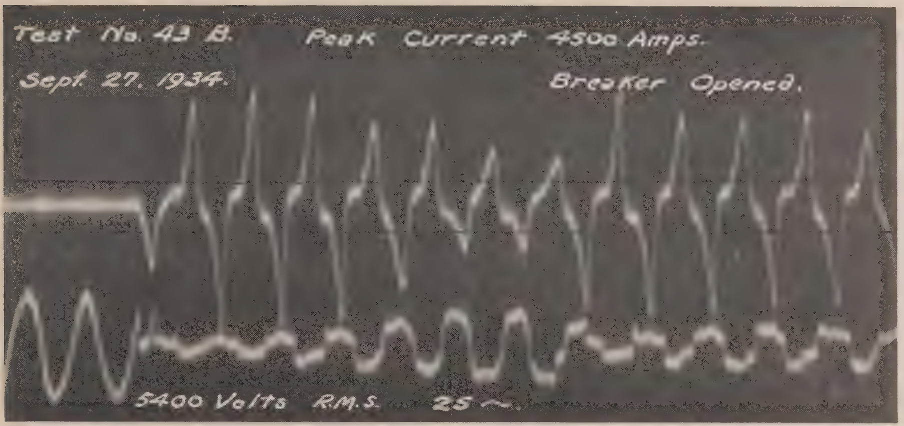

*50 Ampere fuse. Arced and cleared.*

light overloads is eliminated by the mechanical opening of the circuit by the dropping cartridge. If the cartridge has an open top, the opening must be in line with the bore, as while the gas can readily escape through a vent at right angles to the bore, the upper part of the fuse leader will become jammed at this point. From these tests it was not possible to discriminate between those with the closed top and those with a top vent in line with the bore.

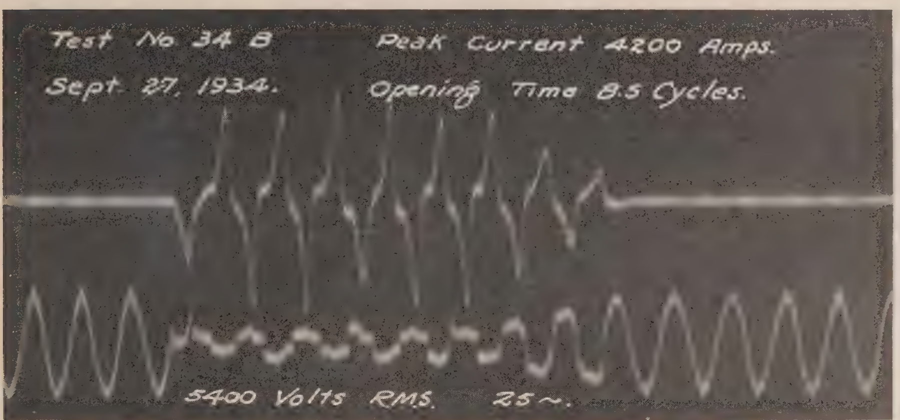
The moving pictures showed that with one switch the arc was cleared before the cartridge started to drop. This resulted in little burning of the contacts.

Some switches dropped the cartridge to the ground under heavy short circuit conditions.

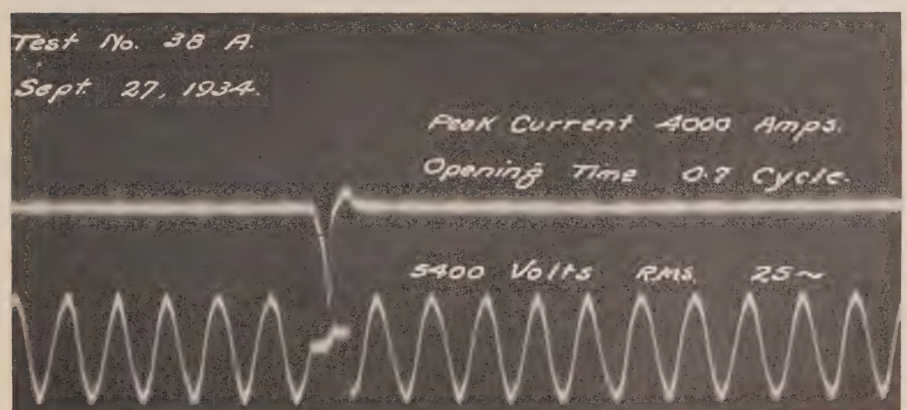
The hanger bracket must be so



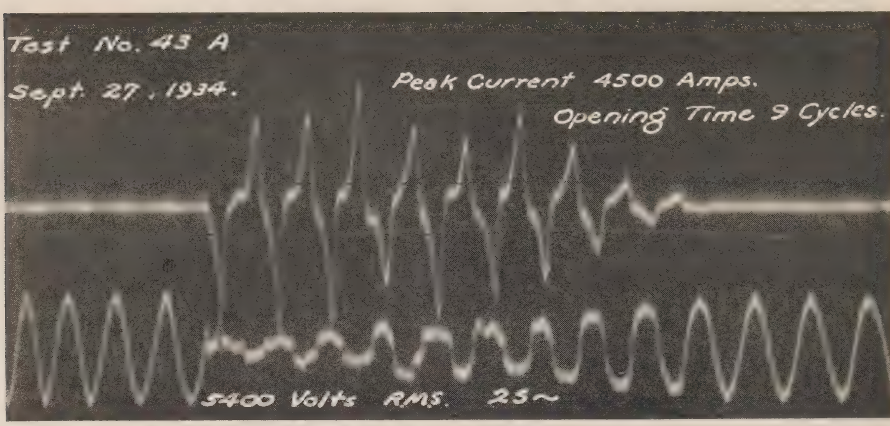

*10 Ampere fuse. Arced. Station breaker opened.*



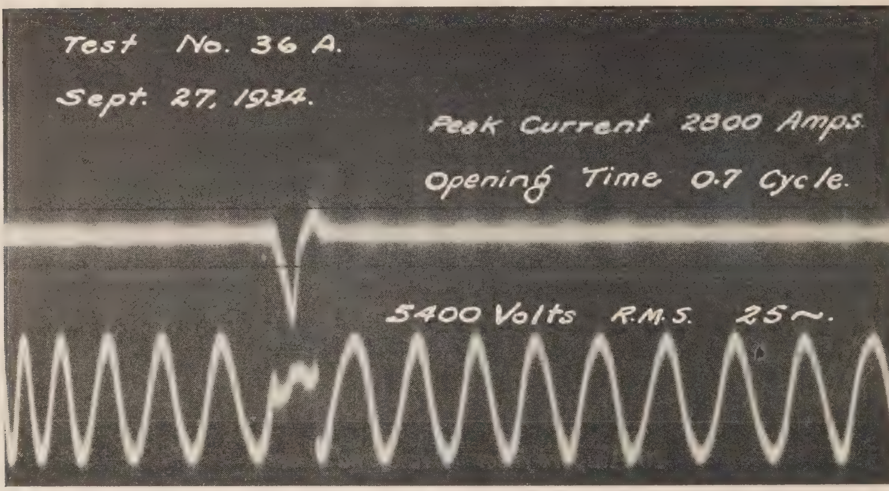

*10 Ampere fuse. Arced and cleared.*




*50 Ampere fuse.*




*10 Ampers fuse. Arced and cleared.*




*10 Ampere fuse.*

designed to withstand a heavy recoil.

With closed box type of cutouts changes in design are necessary to prevent the burning gas from the lower end of the cartridge getting back into the box and shattering the porcelain. Out of seven box cutouts that were shattered in the test, in only one was the cartridge badly damaged.

Municipalities desirous of purchasing fusing equipment can obtain information regarding performance of equipment in these tests by communicating with the Distribution Section of the Electrical Engineering Department.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

# Financing of Hydro

**By T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario**

(*From an Address to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Toronto, January 29, 1935.*)

WHAT I would like to say in a serious moment is this, that coming to this position without solicitation—I didn't ask for it—I came with a very definite purpose. Some of you may remember the great thrill that passed through the Anglo-Saxon world twenty-five years ago now, when King George was crowned, and the Archbishop of York who preached the sermon, chose as the text, "I am among you as one who serves." Very far behind in carrying out that sentiment, I would like to put that before you to-night and before all the people who have to do with Hydro throughout the province, as the model that is going to govern me in any little service I am able to do with the Hydro Power Commission.

It is not going to be an idea of aggrandisement of party or of self. Yet I am coming to this duty with not too much humility because if I had too much humility the gentlemen here would be down raiding the Hydro office. I am coming with the idea that whether my term of service be long or short I will do the best I can, not only for the Commission which is the trustee of this great enterprise, but for the municipalities which I regard as the real owners —may I say the real and ultimate owners of this great system.

The words which I propose to deal with to-night relate to the "Financing of Hydro." I don't want to go back to the beginning of it all, but I want to bring to you to-night a message that I regard as of some importance and which I hope you will regard similarly. I have prepared and will read that part of my remarks which has to do with the capital lay-out of the Hydro-Electric System of Ontario as I see it and you will pardon me for reading it because I want the words that I use reported, rather than something that I may or may not have said.

## CONTENTS

Vol. XXII No. 2
FEBRUARY, 1935



The capital of the Ontario Hydro-Electric System has been advanced very largely from funds raised by the Province of Ontario through the sale of Provincial bonds. Out of $259,000,000 of capital put into the power business operated by the Provincial Hydro some $204,000,000 are represented by these Provincial bond issues. They constitute a portion of the great Provincial obligations, and are not earmarked in any especial way, as representing money advanced to the Hydro by the Government, as a banker would advance money to a client to carry on a private commercial enterprise. At the present some $20,000,000 of this capital, for which the Government is responsible, has been repaid by the operation of the Hydro's sinking funds, leaving the net debt from the Hydro to the Government about $184,000,000.

It had been generally supposed that upon payment of the money, still due the Government, the Provincial Hydro assets, represented by the power developments and transmission plants of the four Hydro systems, would belong to the people of these systems. A recent remark in the course of a judicial investigation indicates that this is not quite so certain as the co-operating municipalities believed. Mr. Leopold Macaulay, in a speech just before the election, added to the uncertainty concerning the ultimate ownership of the Hydro, when he said: "Right now we could get back from a sale of Hydro, our investment, and sufficient profit to cover the whole public debt of Ontario. There are private United States interests which would be glad of a chance to pay that much for it." Another Government speaker, during the campaign, according to a report of a friendly newspaper, said that Mr. Hepburn had been trying to knock the foundation from under the Hydro—"And why? Think of what a fine deal could be made by a Liberal Government in Ontario selling out to the power barons of the United States."

In both of these speeches there is the implication that the Government of Ontario has a beneficial interest in the assets of the Ontario Hydro-Electric Power Commission. May I say that the Province of Ontario has no such interest. It does not own a dollar of the plant and material of the four systems of co-operating municipalities into which the Hydro system has been divided. So long as the interest due on the loans advanced to the Hydro by the Government is duly paid, the Government of Ontario could no more seize and sell to any private interest anywhere the assets of the Hydro, than could a banker sell the property of a solvent merchant who had received advances

from the bank to carry on his business, and was paying back such advances in accordance with the terms of the agreement under which they had been made.

The present Government of Ontario has no intention of assuming powers in this direction which it does not possess, or of regarding the investment in the Hydro as an investment of the Province rather than that of the co-operating municipalities. I have the authority of the Prime Minister for the statement that so far from endeavoring to wrest from the municipalities their investments for the generation, transmission and distribution of hydro-electric energy, the Government proposes to place beyond doubt the position of the municipalities as the ultimate owners of Hydro, when the capital now invested in it by private citizens, who had bought bonds of the Province of Ontario, has been repaid.

A conference was recently held between the Cabinet and the Hydro-Electric Power Commission, at which agreement was reached that this would be accomplished best by the segregation of the capital of the Hydro from the debt of the Province. In pursuance of this agreement, when that portion of the Provincial bonded debt, which falls due during the current year and which was issued fifteen years ago for the construction of the Chippawa power plant, comes up for renewal, it will be refunded not as a direct obligation of the Province of Ontario, but as a bond issue of the Hydro-Electric Power Commission of Ontario, bearing the guarantee of the Province, and in this respect conforming with other recent direct issues of the Commission.

As Provincial bond issues, made to provide capital for Hydro enterprises fall due in the future, the same procedure will be followed so far as practicable, so that ultimately the capital invested in the Hydro-Electric enterprises will be represented by bonds of the Commission rather than by bonds of the Province of Ontario. There would be no doubt then as to "Who owns Hydro." The ownership must manifestly reside in the municipalities which, on behalf of the persons using Hydro-Electric light, heat and power within their boundaries, have made contracts with the Hydro-Electric Power Commission, thus joining the partnership of the various Hydro-Electric power districts in old Ontario.

What I have said does not apply to that part of the Province lying north of North Bay and the line of the French River, (with the exception of the Thunder Bay power development district). There, no general system of local self-government exists and there are few municipalities with which Hydro could make power contracts. The capital investment in that vast district, extending for hundreds of miles north and west, has been made on account of the Government and people of Ontario. This is neither the time nor the place to discuss the wisdom or unwisdom of the Abitibi Canyon Development or the original lease of that great water power to a private corporation which has disappeared from the picture. The supply of power now available in the north has done much to promote

a rapid development of Ontario's gold mining industry. A very important increase is proceeding at the moment in the quantity of firm power supplied in this great region by the Commission as the agent of the Ontario Government.

It is not at all impossible that in the future this service will become a source of considerable new revenue to the Government, and that the serious losses incurred in the early stages of the development will be recouped by profits that will make up for these losses.

May I say, leaving the manuscript for a moment, that it is really a romance, the way the Hydro has been able to act as handmaiden for the gold mining industry. A development is now in process and almost finished for the supplying of power in the district of Patricia which required the carrying in of the supplies used in that development by aeroplane because the period before the freeze-up was so short that had the ordinary means been used—I mean by the batteaux and scows—the plant would have been caught in mid-winter incomplete, and the result of that in that district—I suppose seven or eight hundred miles from here—they are turning on to-day, additional gold crushing and gold mining machinery which will add materially to the wealth of that country. Without water-produced Hydro power, I venture to say that at least one-third of the gold output of Ontario during the current year would not have been possible.

That means a tremendous thing for every one of us in the settled part of the province. There are men from all over, in these industrial towns of eastern and western Ontario, working on material and supplies for these gold mining areas.

I find many public men, who after a quarter century experience of Hydro finances, have a very grave misconception of the obligations of the municipalities arising out of contracts between them and the Provincial Hydro system. Many seem to be under the misapprehension that money of the taxpayers of the Province has, in the past, been devoted, and may at any time be required, for the payments of deficits incurred in the operation of one or other of the Hydro systems.

One finds in almost all of these controversies the statement that the Ontario Hydro is suffering heavy losses, and that they are being made up by tax levies. We all know here that there isn't a word of truth in that.

They do not seem to understand that the four organized systems—that of Eastern Ontario, Niagara District, the Georgian Bay District and the Thunder Bay District—have no financial relationship one with the other: that a profit sustained in any one of them cannot be applied in liquidation of a loss in any other. The truth is that each system operates financially in a watertight compartment, and its relations with the Province consist solely of obligations to repay with interest moneys advanced by the Provincial Treasury on capital account.

At the moment the Niagara System is under some stress, as you all know, because of the necessity to pay large sums to contractors in the Province

of Quebec for power that cannot be profitably used. The only persons concerned with this question are the people of that part of the Province lying between the eastern suburbs of Toronto and the Windsor border, extending north into Wellington, Waterloo, Perth and Lambton.

In that part of the Province embraced in the Georgian Bay system, including portions of Bruce, Huron, Grey, Wellington, Dufferin, Peel and Simcoe, as well as the Muskoka region, the financial troubles of the Niagara System are of no concern to the users of Hydro energy. This is true also of all that part of the Province lying east of the eastern suburbs of Toronto, and of the Thunder Bay district. It will be seen, therefore, that no increases of rates may be made in any one of these four districts to carry deficits in any other. Each must paddle its own canoe. I believe this to be a wise provision.

A single power distribution system, embracing the whole province, would take away from local distributing municipalities much of the keen interest now manifested by you gentlemen in the details of local financing. I believe in local self-government. The nearer the people are to those delegated to do their business, the better will that business be done. The system under which the retail distribution of electric energy is carried on throughout the Province by local authorities, wherever such exist, is I am certain much more efficient and economical than it would be, were the generating and wholesale distributing agency—the Provincial Hydro—to reach out into the municipalities and seek to control retail distribution also.

I am confident, after some months of association with the Attorney General and Mr. McQuesten, in the administration of your great property, that they also hold strongly to the principle of local control of the retail distribution of Hydro power.

The decisive steps taken by the Government to segregate the capital of the Hydro from the debt of the Province is another indication that whatever centralizing ambitions may have existed in the Hydro-Electric Power Commission's offices heretofore, no such dreams of dictatorship now exist.

I want to add to that statement a few remarks about what I might speak of, as my friend Mayor Simpson would, as the higher aspect of the Hydro business. I hope we are not all of us altogether in this business, having money and the money side as our chief concern. For me, from the very beginning, Hydro has been an agency for social reform, for the betterment of the man who is down, and may I also say for the bringing down from the seats of the mighty of some of the men who were then very much up.

You must remember that this Hydro movement in Ontario was as Mr. Mayor Anderson said, a revolt of the people against the domination of a small group of capitalists who at that time seemed to practically rule the roost. I won't mention them by name, they are within the memory of all of us. One of them, one of the men of the group was a tremendous promoter, I think the greatest promoter this country has ever seen, a

man who could go over to London and get all sorts of capital out of those wise fellows on the London Stock Exchange, who before he completed his railroad system to the Pacific had secured almost $500,000,000 of capital, all of which was imperilled by the failure of his great enterprise and all of which to-day, under the control of the Dominion of Canada has not for one day ceased to pay interest on every dollar that was put in by the British investor. That is a remarkable record showing the financial probity of the people of Canada.

But we can say for the Canadian Northern and for the Ontario Hydro Electric Power Commission that from the day of the first issue of a dollar of capital interest has been paid on the due date on all the money that has been provided for these enterprises by private investors. It is a fine thing for Ontario that that can be said. It is a fine thing for Canada. Sometimes we swear to our hurt, and keep our word even though it does hurt, and I hope that the day will never come when we of this country, when we of this province, shall in any way repudiate our bond and our word which is behind our bond.

But to go back to the social side of Hydro. My look at the Hydro idea embraces not only the folk in the cities and towns where all these tremendous improvements are matters of routine now, but to the folk on the frontier and on the farms. If by your efforts gentlemen, in the coming year you can lighten the burden of a few hundred Ontario farm women who now for lack of mechanical equipment have to bend over wash tubs many hours each week, if you can improve the sanitation of this province so that we shall come a little closer to the standards that the Romans established two thousand years ago, I am sure that you will be doing much not only for the health, but for the happiness of the people on the land in this province.

The Hydro in the last few months has offered free power for the operation of washing machines, radios, and power systems for sanitation purposes on any farm in Ontario which has Hydro service or wants to get it. I consider that not an economic measure so much as a measure of social reform, as a measure that will enable us to say on the farms, "Why crowd in to the towns and go on relief lists when you can have, on the farm, the same radio program that you get in Toronto, when you can have as good sanitation as you can have in Toronto, when you can have for your wife and for your daughters all the conveniences that come from the use of Hydro heat and Hydro energy." That to me is the one thing that makes it worth while to start again after having been as I say an old "dug-out," to start again and try to stimulate a re-birth of Hydro in this province.

I am not saying that you gentlemen have not been enthusiastic. Your chairman tells me that there are men here who live and move and have their being in Hydro, but I am saying that for some reason or other during the past few years there has been a slackening of effort and a feeling that one political party or another is seeking to steal Hydro for its own. I hope and believe that that is all at an end.

So far as I am concerned, before I accepted this office, it was on the direct intimation of Prime Minister Hepburn and his colleagues that politics would not play any part in the administration of Hydro. I am trying to keep that pledge that they made to me and I hope that with your help, and with the help of all the gentlemen in the Municipal Associations and Electrical Utilities, it will be possible, not merely in the Hydro headquarters but throughout the province, to pull unitedly as we did twenty years ago when Sir Adam Beck was able to get the generation of electricity put into force over at Niagara Falls. The mayor said a true thing when he said that Niagara Falls had been in the beginning of Hydro the key-note of the development.

I am hoping that we will get back—for the generation of all the Hydro power that we need in this Niagara District for the next thirty or forty years—back to the original source. Not immediately—we couldn't use the power if we had the right to use it. We have too much power. But before I leave office I want to be able to say that the Niagara District, instead of buying power hundreds of miles away, carrying it up into Toronto from Quebec at a great loss, will in the future so enlarge its program at Niagara Falls, that the great bulk of the power used in the next half century in the Province of Ontario shall be generated in publicly owned and publicly operated plants at the falls of Niagara.

Mr. Chairman, I thank you for your kindly and patient reception. I want again to pledge myself to co-operate in the most cordial and whole-hearted way with any of your municipalities that seeks to increase and diversify the Hydro load that you are now buying from us.

## Notice to Electrical Jobbers, Dealers and Buyers of Electrically-heated Warming Pads

The Commission has been studying the safe construction of Electrically-heated warming Pads for some years and in conjunction with the Canadian Engineering Standards Association prepared a draft specification which after full discussion by the Association panel was issued as the Commission's Approvals Laboratory requirements in November, 1933.

Several manufacturers have successfully met these requirements and have therefore obtained a certificate of approval. Approved warming pads may be identified by the Commission's approval number on the label or on the carton.

The sale of unapproved warming pads in the Province of Ontario shall therefore cease on March 1, 1935, in accordance with the regulations authorized under the Power Commission Act, Chapter 57, Section 80.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

W. W. Pope, *Secretary.*

January, 1935.

# Load Building as Viewed by the Hydro Municipalities

## A Symposium of Recommendations for Load Building Campaign as Submitted by the Executive of the Association of Municipal Electrical Utilities to the Hydro-Electric Power Commission of Ontario.

**By E. V. Buchanan, General Manager, London Public Utilities Commission, and D. B. McColl, Manager, Walkerville Hydro-Electric System.**

*(Read to Association of Municipal Electrical Utilities at Toronto, January 29 1935.)*

AN Ontario Hydro load building campaign to be effective must be entered into enthusiastically by the Hydro-Electric Power Commission and its staff as well as by every local commission and its staff. In other words there must be complete co-operation from the smallest hamlet to the largest city, including the rural districts and the Ontario Commission.

Although in the light of present day depression the outlook may be bad, yet when the total surplus power now purchased and contracted for is broken down into units amongst the 540,000 customers of Hydro in Ontario, it does not seem an insurmountable task to sell it if an aggressive sales campaign is followed.

The whole power situation should be reviewed both with regard to surplus and contracted for power, on the one hand, but it should be recognized as a fundamental that there is no difference of interests between the Hydro-Electric Power Commission and the Municipality. As far as the people of this province are concerned, Hydro is all one service for their benefit.

For the purpose of clarifying the situation, the following general observations covering the supply of power by the Hydro-Electric Power Commission of Ontario to the municipalities and through them to the ultimate consumer, are necessary:

1. The cost of power to the municipalities comprises all the costs of the Hydro-Electric Power Commission less any revenue received by the Commission from consumers supplied direct, irrespective of whether all the power available is used or not.

2. The municipalities are required to provide sufficient net revenue from the sale of power to their consumers to pay for the power taken from the Ontario Commission on a cost basis as above, while selling at the lowest and most attractive rates to encourage increased use.

3. Under present operating conditions each municipality has two classes of surplus power available from which increased revenue can be derived as follows:

(a) The surplus or unused power of the Hydro-Electric Power Commission, the cost of which must be paid for by the municipal systems.

(b) The off-peak power of each municipal system from which at present no revenue is derived.

The sale of municipalities' off-peak power has not received the consideration which it apparently merits, as much of this power would undoubtedly be used if offered at sufficiently attractive rates so as to be mutually beneficial to all.

Considerable difficulty has been experienced up to the present time in securing the active co-operation of many municipal systems in the sale of surplus power, largely because there was no incentive to local Commissions to increase their system's peaks, as it is believed that they are penalized to the extent of having to bear the cost of a larger proportion of the Ontario Commission's unsold power than they would if their load was allowed to remain stationary. Consequently many local systems have not considered it to their advantage to aggressively encourage the sale of water heaters and other load building appliances, which the Ontario Commission has been recommending.

While it is essential to increase the municipalities' peak loads, every effort should also be made to encourage the local systems to increase their load factor, through the sale of off-peak power which will serve a two-fold purpose:

1. It will encourage the local commissions to adopt aggressive merchandising policies for the sale of power, knowing that they will derive considerable direct benefit therefrom.

2. The increased net revenue so derived will make the local commissions less timid in encouraging the use of these appliances which undoubtedly will raise the peak load without a corresponding increase in load factor. An increase of rates to the consumer need not then be feared as might be the case with a falling load factor and a rising peak load.

The solution of the problem is, therefore, a matter of aggressive and intelligent merchandising and should be dealt with as such. It will require, as previously stated, definite leadership from the Hydro-Electric Power Commission and the active co-operation of every municipality served by it.

It is, therefore, recommended that consideration be given by the Hydro-Electric Power Commission to organizing a special committee which might be known as the "Load Building Research Committee, or Department," under the direction of a competent and aggressive executive with an able staff of assistants, representing both the Commission and the Municipalities, who would be thoroughly versed in all phases of the problem.

The duties of this committee would be briefly as follows:

1. To make a thorough and exhaustive study of all possible outlets for both surplus and off-peak power, including

(a) Increasing the use by existing outlets.

(b) Developing new outlets and applications for the use of power.

(c) Making a study of municipal load conditions and devising rates to encourage the sale of off-peak power.

2. To undertake the organization of the municipal systems into aggressive selling agencies—

(a) By direct personal contact with local commissions and staffs to secure the most active and enthusiastic co-operation possible.

(b) By assisting the local commissions in analyzing their requirements and contacting their larger or more important prospects.

(c) By acting as a clearing house for the distribution of data and information selected from systems whose efforts have proven successful.

(d) By conducting the necessary advertising and sales promotional campaigns so that the maximum results may be obtained from the efforts put forth.

3. To make use of the laboratory more extensively for investigating all new applications of electricity, and for testing existing appliances, not only for safety, but to find means to increase their efficiency and to improve their design so as to cheapen their cost.

An aggressive sales campaign can develop a vast increase in the use of electricity in the home when the figures of use of appliances and consumption are analyzed. The saturation for appliance use has by no means been reached, and it should be remembered that 90 per cent. of the domestic customers in Ontario are using less than the average. This statement also applies nearly as much to the commercial lighting field and in a lesser degree to the industrial power situation. A vast amount of power can be disposed of at low rates for electric heating other than room or building heating; in suggesting low rates it is not intended that the basic rate structure should be tampered with but rather that the customers' load factor should be increased by making use of the third rate for the new applications. Increased discounts for the sale of the municipalities' off-peak power would attract new loads without interfering radically with the rate structure. Although off-peak power does not bring directly any increased revenue to the Hydro-Electric Power Commission yet the municipality having earned more money can afford to pay more for its power through the 13th power bill or in some other way. The sale of off-peak power does not involve the municipality in any extra investment for distribution.

As mentioned before, the domestic load both urban and rural offers the greatest immediate field. This load is not only worth while pursuing because of the immediate economic benefit to the Commission but also for reasons which transcend the economic, namely, improvements in the standard of the living of the people.

The local utilities must become aggressive in local appliances and load building sales and do it now. If the decision locally, however, is against direct utility selling then the indirect effort must be much greater. T. K. Quinn, Vice President of the General Electric Company said recently, "It is well enough to turn the load building responsibility over to distributors and dealers, providing they understand and accept that responsibility and are held collectively accountable for predetermined results. Simply to stay out of merchandising without organizing the dealers or checking and helping them, is not turning over the responsibility—it's just careless abdication."

In every effort to sell appliances the local utilities must lead the parade. This has been demonstrated over the past three quarters of a century all over the world by the gas utilities whether private or publicly owned, and later by electric utilities in both categories.

The electrical industry was originally developed on the business of lighting. For many years electric light has been taken for granted. More recent studies in the art of seeing have definitely demonstrated that the usual intensities from artificial sources are of the order one to five foot candles whereas noon-day sun has an intensity of ten thousand foot candles. This demonstrates the total inadequacy of our artificial lighting system. The consumption of power for lighting can be increased ten times without nearly reaching the ultimate goal. Attention should be given to "Better Light—Better Sight" campaigns recently inaugurated in the United States. Consideration might be given to the question of bonusing the consumer in some way either by gift or reduced prices of lamps 100 watts and over. This method should be justified in the same manner as the free water heater installation.

The largest load builder for the smallest investment is the water heater. It is also the best load builder especially for the Hydro System because of its one hundred per cent. load factor. It also gives the housewife one of the greatest boons in good housekeeping. With proper and thorough education, a water heater campaign can be made a success. There is every reason to believe that 50,000 water heaters can be installed per annum on Hydro consumers' premises.

The possibilities of converting this type of load to an entirely off-peak load should be investigated. This would necessitate increasing both the size of the storage tanks and the heating units, together with the development of efficient low cost control equipment. Many of the consumers' difficulties with the present flat rate equipment would be eliminated. At the same time, a tremendous increase in the number of electric water heater installations throughout the province should result through more attractive rates.

The next best load-building appliance is the electrical cooking range. Much education is apparently still required on the advantages of electric cooking. The installation of heavy range wiring is a stumbling block which should be overcome either by paying for the range wiring or installing it on rental. Long term payments should be made available for the sale of ranges, and even the installation of ranges for short periods, say up to six months on a nominal rental basis would meet with success. In both of these activities, *i.e.*, the water heater and the range, the training of a great staff of employees should be undertaken. Other appliances such as hot plates, toasters, ironers, refrigerators and washing machines should not be forgotten, because although these in themselves do not produce a large revenue they are appliances which the people should have, and at the same time they stimulate interest in the electrical idea, helping the sale of water heaters

and ranges and attracting attention to the new electrical devices such as air-conditioning equipment.

Industry offers many appliances for small electric heating units of a size such that neither the cost of equipment or power is of much importance to the consumer, and where his only consideration is to get the job done in the most satisfactory manner. Metal melting pots, small requirements of process steam, furnaces of various types and ovens, are other jobs where electricity excels in results. There are plants where steam could be produced to advantage electrically during the summer.

In the commercial field, signs, store-lighting and commercial cooking offer wide fields. The advantages of electric cooking in restaurants and hotels is so pronounced that one wonders why more development has not taken place. The only reason appears to be the lack of suitable rates and sales aggressiveness.

*Cooking Demonstration at Galt Hydro Shop, February 4th to 9th, 1935. Average attendance for 6 afternoons was 296. R. H. Hatcher, Manager.*

# Prospects for Selling 100,000 Horse-power to Domestic Users in the Next Three Years

By G. J. Mickler, B.A.Sc., Sales Department, H.E.P.C. of Ontario

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 29, 1935)*

IT is a fact that we have a surplus supply of electrical energy awaiting a permanent market. It is also true that during the present depression the consumption of current by domestic users has not shown the decline which has been so pronounced among commercial lighting and power users. In fact, up until 1933 the total consumption among domestic consumers has increased as has the average use as is revealed by the following figures (Table No. 1):

The total average annual consumption is now approximately 1,600 kilowatt-hours. It is nevertheless true that there is a vast number of domestic consumers who consume much less energy than this average. Figures compiled by a reliable authority show that (see Table No. 2):

It would thus appear that about 71 per cent. of the consumers are below the average in consumption.

A well-equipped home of an average family should contain an elec-

TABLE No. 1

| Year | Number of Consumers | Total Domestic Consumption Thousands of Kw-hr. | | | | Average Monthly Domestic Consumption Kw-hr. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Cities | Towns | Villages | Total | Cities | Towns | Villages | Total |
| 1914 | 64,866 | 12,646 | 1,415 | 291 | 14,352 | 21.8 | 17.4 | 13.1 | 21.0 |
| 1917 | 131,313 | 36,693 | 3,825 | 1,413 | 41,931 | 30.5 | 21.4 | 14.0 | 28.6 |
| 1920 | 193,892 | 84,328 | 10,053 | 3,830 | 98,211 | 48.4 | 36.0 | 21.2 | 44.6 |
| 1923 | 286,852 | 206,266 | 25,411 | 11,429 | 243,106 | 83.5 | 60.1 | 33.7 | 75.7 |
| 1926 | 349,882 | 324,290 | 50,487 | 29,945 | 404,722 | 108.0 | 89.6 | 54.4 | 98.4 |
| 1929 | 424,419 | 497,102 | 68,283 | 46,755 | 612,140 | 137.2 | 97.8 | 67.2 | 122.5 |
| 1930 | 433,260 | 541,877 | 72,234 | 55,917 | 671,028 | 144.4 | 105.0 | 80.1 | 130.1 |
| 1931 | 447,466 | 567,940 | 78,359 | 58,485 | 704,784 | 148.3 | 108.1 | 78.4 | 133.0 |
| 1932 | 452,615 | 593,619 | 81,054 | 66,227 | 740,900 | 152.8 | 107.5 | 83.7 | 136.4 |
| 1933 | 460,878 | 595,222 | 82,322 | 64,651 | 742,195 | 150.0 | 107.3 | 81.2 | 134.2 |

TABLE No. 2

Figures compiled by a reliable authority show that:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30% | of Hydro | Domestic | Consumers | use | less than 600 kw-hr. per annum. | | | | |
| 30% | " | " | " | " | between | 600 & 1200 | kw-hr. | per | annum |
| 11% | " | " | " | " | " | 1200 & 1600 | " | " | " |
| 10% | " | " | " | " | " | 1600 & 2400 | " | " | " |
| 14% | " | " | " | " | " | 2400 & 5400 | " | " | " |
| 5% | " | " | " | " | over | 5400 kw-hr. per annum. | | | |

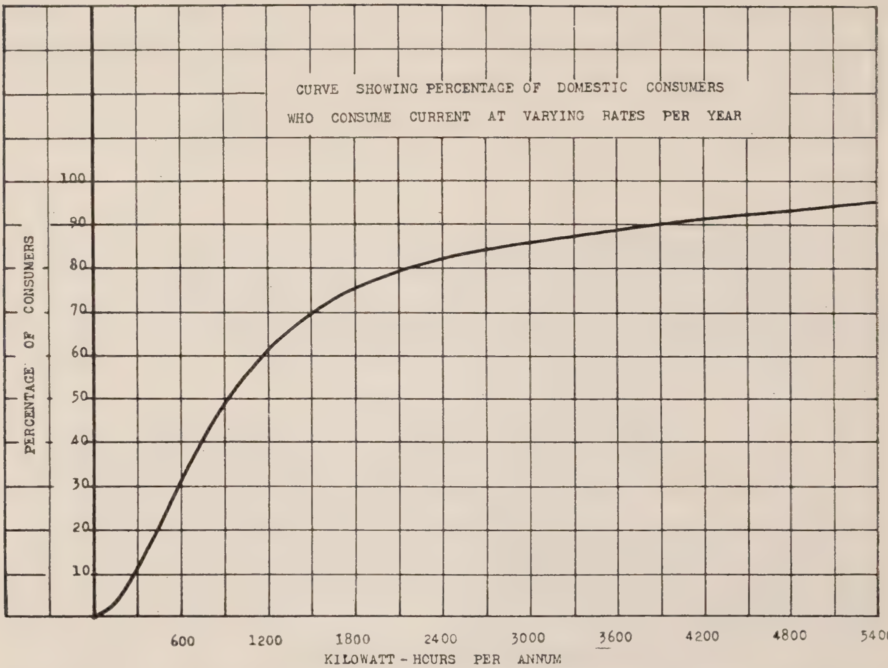



*Chart No. 1—This chart was prepared from an estimated classification of consumers in some of the larger municipalities according to consumption.*

tric range, refrigerator, water-heater, blower or oil burner, irons, ironer, air-heaters, vacuum cleaner, radio, fan, electric washer, dish washer, toaster and some smaller appliances as well as lighting fixtures and floor and table lamps to properly illuminate the home.

A conservative estimate of the consumption of a properly equipped home is between 500 kilowatt-hours and 1,000 kilowatt-hours per month with an average placed at about 800 kilowatt-hours. Comparing this figure with the average for the Province of 133 per month, it is at once apparent that six times the number of appliances now in use must be installed to bring the total average consumption up to the possible average.

During the past 9 years an annual survey has been made of the number

of major electrical appliances in use among Hydro consumers, in order to watch the progress toward saturation. The following tables show what has been accomplished by the electrical industry in equipping Ontario homes with modern electrical conveniences.

From the above figures (Table No. 3) it will be seen that there has been a very substantial growth in the number

TABLE No. 3

| | End of 1924 Estimated Number Appli-ances in Use | Satura-tion | End of 1933 Estimated Number Appliances in Use | Satura-tion | Increase in Nine Years | Aver-age Added Per Year |
|---|---|---|---|---|---|---|
| Number of Domestic Consumers served | 344,250 | | 464,319 | | 130,069 | 14,452 |
| Electric | | | | | | |
| Ranges.......... | 47,505 | 13.8% | 123,352 | 26.6% | 75,847 | 8,427 |
| Hot Plates....... | 18,883 | 5.5% | 61,866 | 13.3% | 42,983 | 4,776 |
| Washers......... | 55,342 | 15.8% | 171,327 | 36.9% | 115,985 | 12,887 |
| Cleaners......... | 64,205 | 18.6% | 123,797 | 26.6% | 59,592 | 6,621 |
| Water-Heaters, Flat Rate..... | ..... | ..... | **19,753 | 4.2% | 19,753 | 2,195 |
| Water-Heaters, Metered....... | 16,665 | 4.8% | 34,306 | 7.4% | 17,641 | 1,960 |
| Grates.......... | 15,075 | 4.4% | 21,819 | 4.7% | 6,744 | 749 |
| Air-Heaters...... | 103,000 | 30.0% | 141,986 | 30.6% | 38,986 | 4,332 |
| Ironers.......... | 1,590 | .4% | 5,912 | 1.3% | 4,322 | 480 |
| Irons........... | 307,800 | 89.2% | 434,413 | 93.6% | 126,613 | 14,068 |
| Refrigerators..... | 657 | .2% | 45,382 | 9.8% | 44,725 | 4,958 |
| Toasters......... | 152,200 | 44.1% | 234,603 | 50.5% | 82,403 | 9,156 |
| Grills........... | 46,800 | 13.1% | 43,735 | 9.4% | 3,065 | 341 |
| Oil Burners and Blowers....... | ** | ..... | 13,208 | 2.8% | 13,208 | ..... |
| Air Conditioners.. | ** | ..... | 531 | .1% | 531 | ..... |
| Radios.......... | ** | ..... | 271,574 | 58.5% | 271,574 | ..... |
| Total Estimated Installed Capacity.. | 806,901 kw. | | 1,653,993 kw. | | 847.092 kw. | 94,121 kw. |

** No record for 1924.

| | | | |
|---|---|---|---|
| Average Installed Capacity per Consumer ...... | 2.350 watts | 3.560 watts | 1.210 watts about 50% increase |

of large current consuming appliances such as ranges, hot plates and water-heaters, while the increase in the number of smaller appliances has not been so marked. The total estimated installed capacity of all appliances has doubled in the 9 year period.

In arriving at the total estimated installed capacity, the following individual average capacities were used (Table No. 4):

While it is practically impossible to determine the effect of each of the above appliances on peak loads in each municipality or on any system of municipalities during all seasons of the year, nevertheless, they all do affect the peak—the average yearly peak to some extent—and they all consume current. For the purpose of argument an estimate of the peak created by and the consumption of each appliance has been attempted as shown above.

Obviously, any effort to increase the sale of peak load power would have to be concentrated on such appliances which have the greatest effect on the peak.

Electric ranges, hot plates, flat rate and metered water-heaters, refrigerators and air conditioners fall into that class.

TABLE No. 4

| | Estimated Capacity (watts) | Estimated Effect on Peak in kw. | Estimated Annual kw-hr. |
|---|---|---|---|
| Electric Range | 6,000 | 1.000 | 2,400 |
| Electric Hot Plate | 2,000 | .300 | 500 |
| Electric Washer | 200 | .025 | 36 |
| Electric Vacuum Cleaner | 200 | .025 | 36 |
| Electric Water-Heater—Flat Rate | 600 | .500 | 4,000 |
| —Metered | 2,000 | 1.000 | 2,000 |
| Electric Grate | 2,000 | .200 | 240 |
| Electric Air-Heater | 800 | .100 | 100 |
| Electric Ironer | 1,200 | .120 | 100 |
| Electric Iron | 660 | .066 | 48 |
| Electric Refrigerator | 200 | .200 | 720 |
| Electric Toaster | 550 | .055 | 36 |
| Electric Grill | 660 | .066 | 36 |
| Electric Oil Burner and Blower | 200 | .100 | 180 |
| Electric Air Conditioner | 1,000 | .100 | 200 |
| Electric Radio | 100 | .010 | 60 |
| | 18,370 | 3.867 | 10,692 |

A study of Table No. 3 shows the saturation of each of these in Ontario to be:

TABLE No. 5

| | |
|---|---|
| Electric Ranges | 26.6% |
| Electric Hot Plates | 13.3% |
| Electric Water-Heaters— | |
| Flate Rate | 4.2% |
| Metered | 7.4% |
| Electric Refrigerators | 9.8% |
| Electric Air Conditioners | 0.1% |

What are the possibilities of sale among the new users of the above list of appliances.

### Electric Ranges

In Ontario, there are a large number of municipalities in which either natural gas or privately owned artificial gas plants compete with electricity for cooking purposes—in all 86—representing 326,557 domestic electric consumers. Then there are 12 municipalities in which municipal gas plants are operated—mostly by the same Commissions as operate the Hydro—representing 43,408 domestic electric consumers. The number of electric ranges estimated to be in use in these municipalities is 91,120 and 10,561 respectively, or a saturation of 27.1 per cent.

The total number of urban domestic consumers is 459,344 at the end of 1933; thus the number of consumers not affected by gas competition is 89,448 and in these the saturation in ranges is 24.4 per cent.

In some of these municipalities the number of electric ranges installed is very high compared to the number of consumers, notably

| | Saturation |
|---|---|
| The Border Cities | 61% |
| London | 46% |
| Stratford | 56% |
| Kitchener | 37% |
| Weston | 39% |
| Niagara Falls | 65% |
| Ottawa | 52% |
| Galt | 38% |
| Woodstock | 37% |
| Mimico | 41% |
| St. Thomas | 35% |

Any campaign to sell a large number of ranges in these localities would naturally produce a much lower percentage of sales than can be hoped for over the Province as a whole. On the other hand, such municipalities as:

| | Saturation |
|---|---|
| Toronto | 20% |
| Kingston | 5% |
| Peterboro | 16% |
| Guelph | 17% |
| Hamilton | 27% |
| Brantford | 23% |
| East York | 10% |
| North York | 25% |
| Sarnia | 23% |
| Scarboro | 24% |
| St. Catharines | 27% |
| Belleville | 21% |
| Midland | 25% |

and all other municipalities below the average offer a much more fertile field for future range sales.

In order to strike a quota for all municipalities in all systems, the above facts must be taken into account.

Supposing it is assumed that in the gas competition towns exclusive of the Border Cities, Stratford, Niagara Falls and Ottawa, a flat 20 per cent.

increase in the number of new electric range customers were set as an objective, a total of 15,000 ranges would be added. Then assume an increase of 10 per cent. possible in the 4 localities excluded above, another 2,700 ranges would be added and assuming 30 per cent. added in all remaining municipalities 6,500 ranges would be added, a grand total of 24,200 ranges. As a three year objective this is not impossible since the 9 year average has been 8,427, although the average for the last 3 years has been little more than 4,000.

Perhaps a higher objective should be set. It must be remembered, however, that in the majority of municipalities those now using electric ranges are among the higher income classes and those whom we must induce to install electric cooking fall into the lower income brackets. It is said that over 75 per cent. of the families of urban communities in Ontario come within the income group of $1,500 or less per annum, the average income of this group being not over $1,100 even in prosperous times. A great many of these families cannot afford to discard their present cooking equipment to purchase an electric range for reasons which will be more fully outlined later on.

So far, only urban possibilities have been discussed. The rural consumers of Ontario present a field for further extension of the use of the electric range. No recent data are available from which can be estimated the number of hamlet and farm consumers in rural power districts who are cooking by electricity. It is safe to assume, however, that the saturation among this class is less than that of urban municipalities.

There are about 64,000 rural consumers now using Hydro, 35,000 hamlet and 29,000 farm users. If we assume a present saturation of 20 per cent. or 12,200 ranges, and assume a 25 per cent. increase possible during the next 3 years, 3,000 more ranges will be added to our lines.

### Electric Hot Plates

The electric hot plate is in many cases an auxiliary to a range, or is installed as a makeshift until a range can be purchased. It is also a means of cooking for many Summer cottage users for a short period of the year only. For this reason it is difficult to determine what are the possibilities of increasing the use of this appliance. Reports to hand, however, show that the growth during 9 years has been nearly 5,000 per annum in urban municipalities only. We can assume that this growth will continue during the next 3 years. Add to this the possible growth in rural districts and a total of 6,000 hot plates may be added to Hydro lines per annum or 18,000 for 3 years.

### Water-Heaters

Prior to 1933, our records show that there were in use among our consumers approximately 9,300 flat rate water-heaters and 32,100 metered water-heaters, all of varying capacities. Since the H.E.P.C. Water-Heater Campaign was launched we have added approximately 21,000 flat rate heaters and about 3,000 metered heaters to Hydro lines creating a peak of nearly 23,000 horsepower. This increase in flat rate and metered water-heaters has the effect of increasing the

TABLE No. 6
ALL SYSTEMS

| Local Conditions | Number of Municipalities Affected | Number of Domestic Consumers Affected | Rural Consumers Hamlet and Farm Estimated Only |
|---|---|---|---|
| (a) No Water Works | 135 | 27,316 | 50,000 |
| (b) Natural Gas Competition | 71 | 73,470 | ? |
| (c) Artificial Gas Competition—(Privately owned) | 15 | 251,087 | ..... |
| (d) Artificial Gas Competition—(Municipally owned) | 12 | 43,408 | ..... |
| (e) Water-Heater Flat Rates over 75c per 100 watts per month | 13 | 3,001 | ..... |
| (f) Free of competition and favourable otherwise | 52 | 61,062 | 10,000 |
| TOTAL | 298 | 459,344 | |

saturation in flat rate water-heaters from 2 per cent. to about 7 per cent. and metered water-heaters from 7 per cent. to about 8 per cent., both of which figures show that there is still a vast field for new water-heaters awaiting cultivation.

In considering the possibilities of adding large number of water-heaters to our lines, cognizance must be taken of the following facts:

1. There are many smaller municipalities in which no pressure water systems exist.

2. Rural consumers have likewise as a rule no pressure system permitting the use of an automatic hot water service. It is estimated that not over 15 per cent. of rural and hamlet consumers have a water system.

3. Many municipalities are faced with gas competition—natural gas at low rates and high B.t.u. rating and artificial—municipally owned as well as privately owned.

4. In many municipalities the flat water-heater rates are too high to make water heating by electricity economical.

The table above (Table No. 6) shows to what extent each of the above conditions affects the domestic consumer picture.

In breaking down the above figures other facts must be taken into account, the habits of some urban consumers and unemployment. That is to say, first of all, many people do not regard continuous and plentiful hot water as a necessity. They never had it and never will. Many others would like to have it but cannot pay for it just now. Taking these conditions into account it should be possible in:

| Class | | | |
|---|---|---|---|
| (b) | to install | 5,000 | flat rate heaters |
| (c) | " " | 20,000 | " " " |
| (d) | " " | 3,000 | " " " |
| (f) | " " | 5,000 | " " " |

This estimate is based somewhat on the rate at which heaters have been going in during 1934—about 200 per week over all systems and under all conditions.

No water heating service is considered complete without a booster to help the flat rate heater over the peak. Yet despite this fact less than 20 per cent. of water-heater consumers elect to install such auxiliary heating facilities. Even so, spread over the list of consumers enumerated above it is estimated that at least 6,000 booster or metered water-heaters should be installed during the next 3 years.

### REFRIGERATORS

With electric refrigerators we have not the obstacles to overcome which obstruct the sale of electric ranges, hot plates and water-heaters. Everybody needs refrigeration. The cost of electricity for making cold is not any more than the cost of ice and electric refrigeration is much more dependable, steadier, colder and cleaner. The chief difficulty to be overcome in selling refrigerators is the cost and how to meet it. Recently, the manufacturers of this appliance have introduced into the market models priced to fit almost anyone's pocket book and sales organizations are offering terms which would tempt a pauper. All that remains is to offer a little extra bait to clinch a deal for a new modern electric ice-box.

Up until 1927 electric refrigerators in Ontario were more or less of a novelty. Then they began to find their way into Hydro consumers' homes in numbers and since 1927 the estimated average number of refrigerators installed is about 6,000 per annum—the number increasing each year. Today, the saturation is estimated to be about 10 per cent. This means that over 400,000 Hydro consumers need and are prospects for electric refrigeration. With the intensive drive being exerted by manufacturers, the increasing number of retail outlets, the advertising received through satisfied users, the easy terms offered to purchasers and the increasing emphasis being put on food preservation as a means to health, the electric refrigerator seems destined to make even more rapid strides from now on than in the past. It is not impossible to reach an objective of 10,000 units per annum if the present rate of increase in use keeps up or 30,000 units in 3 years.

### AIR CONDITIONERS

Electrical equipment for washing and humidifying for domestic purposes in Winter time and de-humidifying in Summer time is of such recent birth as to render it impossible to judge as to its future. Then, too, it is considered by many as a faddy luxury and it is expensive. In spite of these drawbacks, air conditioners are coming and coming fast and their load is worth considering in any load building campaign. It is a year round load with a good consumption.

If we assume that 5,000 of these appliances will be added to Hydro lines in the next 3 years the estimate will be conservative.

TABLE No. 7

| | Estimated Number Which can be Added in 3 years | Estimated Effect on Annual Peak h.p. | Estimated Annual Kw-hr. Consumption |
|---|---|---|---|
| Electric Ranges | 27,200 | 36,000 | 64,280,000 |
| Electric Hot Plates | 18,000 | 7,200 | 9,000,000 |
| Flat Rate Water-Heaters | 33,000 | 33,000 | 132,000,000 |
| Metered Water-Heaters | 6,000 | 8,000 | 24,000,000 |
| Electric Refrigerators | 30,000 | 8,000 | 5,760,000 |
| Electric Air Conditioners | 5,000 | 650 | 1,000,000 |
| Other Appliances and Illumination | ..... | 7,150 | 20,000,000 |
| | | 100,000 | 256,040,000 |

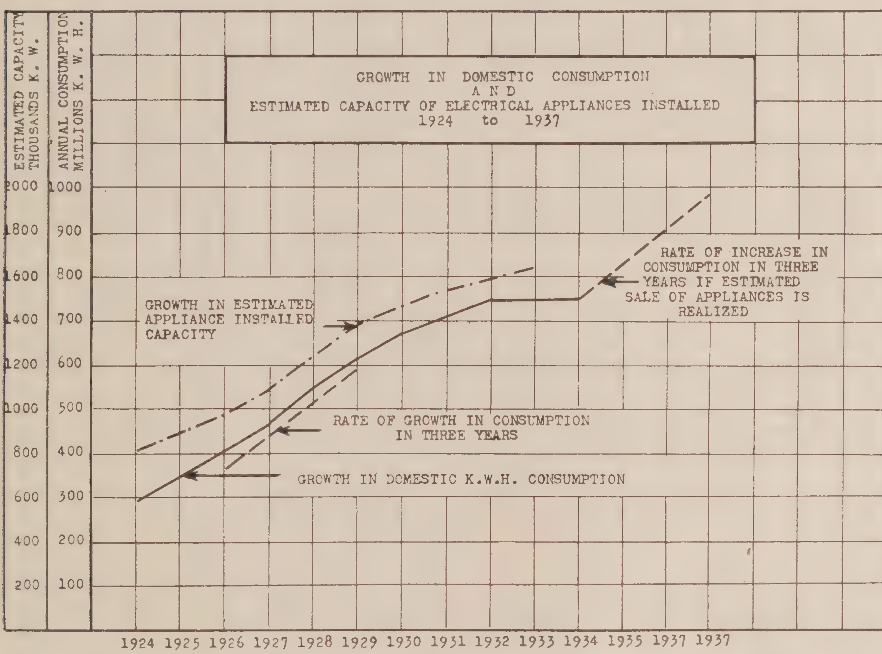



*Chart No. 2—Shows the relation between the installed capacity of electrical appliances and the consumption of electricity by domestic users. The upturn of the consumption curve at the right covering a three-year period if applied to the actual curve for the years 1926 to 1929 shows that to add the appliances necessary to produce the estimated three-year consumption was a normal job in 1926, 1927, 1928, and 1929. That is to say to add 100,000 horsepower during three years is not expecting the impossible.*

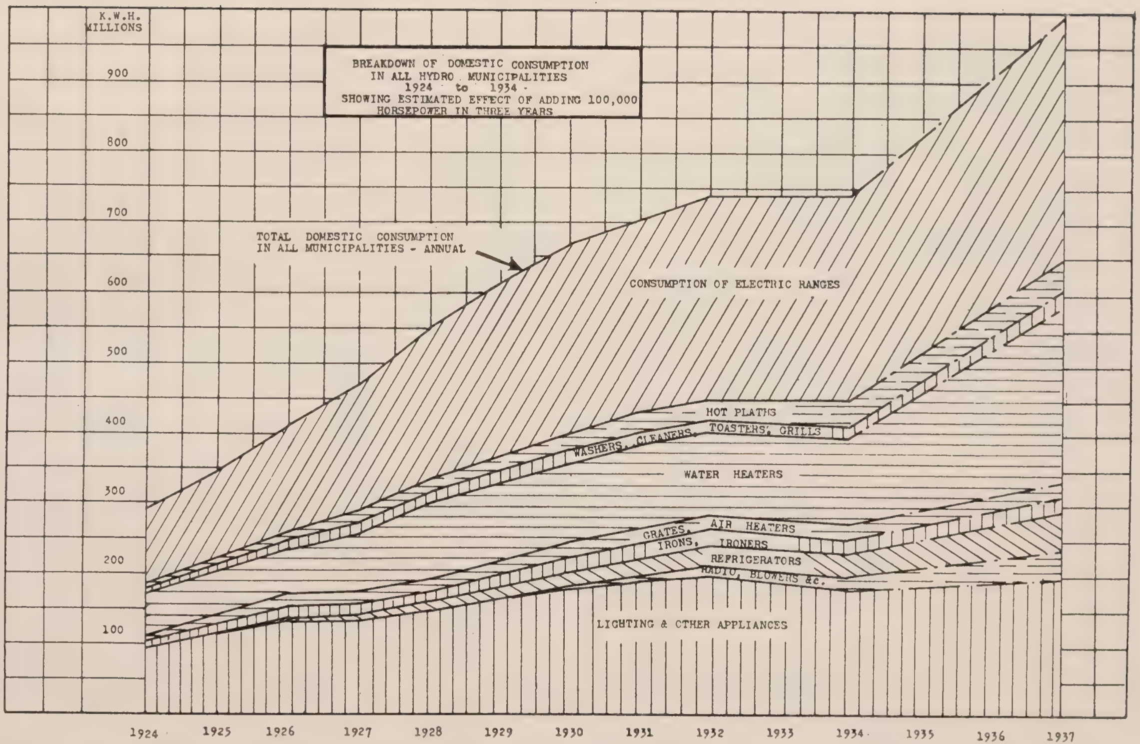



*Chart No. 3—In preparing this chart the estimated number of appliances in use in all the Hydro Municipalities for each year was employed as well as the estimated installed capacities and estimated annual consumptions as shown in Table number 4.*

*The annual consumption for 1934 not being available is assumed to be the same as 1933.*

*The effect of adding 100,000 horsepower with the corresponding kilowatt-hour consumption over a three-year period is shown on the chart and applied to the years 1935, 1936 and 1937. This section of the chart can be moved to the right and applied to the years in which the actual rate development takes place.*

*A fair picture of the relative importance of various appliances from a power consuming standpoint is a feature of this chart.*

### Other Appliances

When we look at the figures showing the numbers of other appliances being installed each year, each contributing its share to peak loads, we realize that the smaller current users such as washing machines, ironers, grates and air-heaters, toasters, oil burners and coal blowers, on account of their numbers, represent an appreciable load increase each year. If the present rate of growth in these lesser appliances keeps up for the next 3 years there will be a substantial load increase as a result.

### Illumination

The step from gas and kerosene to electric light revolutionized the science of seeing—the development in electric lamps from the original carbon lamp to the present high efficiency gas-filled lamp has been almost as revolutionary. The fact, however, that the facilities are available for perfect vision does not mean that we all make use of them—far from it.

Scientific research has proven that a very small percentage of us use the correct amount of illumination in the performance of our daily tasks—that many schools are very poorly lighted. Most factories, offices and streets are a long way from lighting perfection, and in a large percentage of homes, reading, study, recreation and even household duties are performed under lighting conditions which are conducive to injury to the eyes and are the cause of much physical and mental discomfort.

If a study were made of the requirements of the average home and the sizes of lamps increased to meet these requirements, there is little doubt but that the average wattage of lamps installed and used would be very materially increased and the effect of this increased wattage would be felt to a marked degree on the peak load of all systems. No estimate of such a load is possible but a figure has been arrived at to round out the figures already obtained for other uses.

### Re Rural Power Load

In previous paragraphs the load building possibilities in electric ranges, hot plates and water-heaters in rural districts were considered along with the urban picture. There is a big field of rural possibility in electrical farm equipment such as grain grinders, pumps, milk coolers and the like, all of which add their increment to the peak load and to consumption of kw-hr. This study, however, deals with domestic load building only, and aside from mentioning the above no estimates have been made of the possible effect of a strenuous load building effort to stimulate the further use of electrical farm equipment.

Summing up the various estimates which have been made the possibilities for sale and load building are as shown in Table No. 7.

### How Can This Be Accomplished

In order to bring about the increase in use of electricity as outlined the electrical industry including the Commission, the municipalities, manufacturers and dealers will have to be reorganized and many traditions and life-long practices and prejudices set aside. Briefly stated, the reorganization should incorporate some of the following general principles:

1. The formula for determining the peak loads of municipal systems and the method of charging for power should be explained to show that increasing load by the addition of appliances will not increase the basic cost of power.

2. An educational program should be carried on, sponsored by the H.E.P.C. and supported by all other branches of the industry to demonstrate the advantages and economies attending the broader use of electricity in the home.

3. In municipalities where merchandising is carried on a more aggressive policy should be adopted to encourage the sale of appliances.

4. More municipalities should engage in merchandising activities to stimulate interest in the sale of appliances.

5. Closer co-operation between local systems and dealer outlets is necessary to breed harmony and insure better service to all.

6. Where Hydro Shops—so-called—are operated, they should be put on a self-sustaining basis. This can be accomplished only by installing in each a standard accounting system whereby their operations can be properly accounted for.

7. Close supervision of all Hydro Shops is necessary to insure uniform practices and prevent unfair competition.

8. The H.E.P.C. should inaugurate a sales medium for the benefit of rural consumers.

9. Adequate 3-wire services to permit the use of large appliances should be installed free to consumers as part of a local distributing system.

10. Existing 3-wire services should be purchased at a nominal figure to be fair to consumers who have built the load up to present proportions.

11. Each municipality should inaugurate a Service Department to keep in service appliances already connected or installed.

12. Periodic provincial campaigns to promote the sale of ranges, refrigerators and lighting should be carried on in co-operation with manufacturers and others.

13. A vigorous impetus should be given to the present H.E.P.C. water-heater campaign.

14. A Sales Budget or quota should be set for each municipality for all appliances.

15. The employees of the Commission, the Municipal Utilities and the Electrical Appliance Manufacturers should be organized into one vast selling force.

16. Facilities must be provided to finance the purchase of larger appliances on long terms.

17. Constant efforts should be put forth to improve the lighting in the home, in schools, factories, offices and on streets and highways.

18. Sales Conventions should be held attended by all branches of the industry—and U.S.A. Conventions should be attended by H.E.P.C. representatives to get the benefit of sales activities across the border.

19. Encouragement should be given by H.E.P.C. to the development and introduction of new appliances representing new uses for electricity.

20. The municipalities should be banded together into a league to promote adequate wiring to insure the use of more appliances.

21. The Commission should have a permanent exhibit—of outstanding features—at the C.N.E.

* * * *

Explanations and Reasons Underlying Principles Outlined Above

*1. Re Power Cost Formula.*

It is a well-known fact that a number of municipalities in which the range and water-heater load affects the municipal peak manipulate industrial and municipal power loads so as to offset the peak created by these appliances. Some municipalities are loath to add ranges or water-heaters to their lines because of the increased peak thus created and one municipality where a municipal gas plant is in existence had adopted the policy of promoting the sale of gas ranges in preference to electric ranges so as to save the peak load.

It has also been stated that to increase the appliance load, thus increasing the municipal peak, is detrimental to certain municipalities because of the fact that such increase carries with it a greater proportion of the cost of unused power; also that unless all municipalities increase their load those whose load stands still or is reduced benefit by load building which other municipalities might do. As any load building campaign or policy must of necessity create peak loads, an explanation of the method by which the cost of power is determined is necessary to show the effect of adding appliance load and to counteract the effect of the conditions as outlined.

*2. Re Educational Program.*

While it may be assumed that electricity as a means to greater comfort and convenience in the home has received general acceptance in Ontario, statistics have been presented which show that there is a large number of Hydro consumers who are not yet aware of the advantages and economies attending the use of electricity for this purpose. There are too some of our consumers who have abandoned the use of electrical appliances because they were either not aware of the advances made in the art of appliance manufacture or were not properly educated in the use of the appliances they had so as to effect economies in the operation of them. It can be proven that the use of the electric range, water-heater, refrigerator and other appliances can be as economical as performing the functions of these appliances by other means and a great many must be ready for such proof if it can be given to them.

In order to keep constantly before our consumers the benefits to be derived from the use of electricity, some form of educational literature should be distributed to them periodically, either by simple pamphlets such as are distributed by the Telephone and Gas Companies also by the Winnipeg Hydro system or by newspaper and magazine articles. It is believed that the most effective method of education is through a pamphlet distributed along with bills for electric service.

*3. Aggressive Merchandising Policy*

There are about 50 Hydro municipalities in which the local system engages in merchandising. A large number of the Hydro Shops are not at all active in the sale of electrical appliances. In some, sales are made only because customers desire to purchase some appliance or other now

and again. Practically no advertising is done and no attempt is made to go out after business. In some of the larger municipalities merchandising is a serious business and every effort is put forth to increase the load on the local system by the sale of current consuming devices not only through the local shop but assistance is given to dealers to do their part in effecting sales.

It has long been a controversial point as to whether a local system should engage in merchandising or not but there is plenty of evidence to show not only in Ontario but in the United States as well that where the local utility aggressively merchandises or promotes the use of electricity there is a higher saturation of electrical appliances in use and the consumption of electricity is greater than elsewhere. There are, of course, exceptions to this rule; low rates for electricity or high gas rates, or other conditions, have in some cases produced the same results as though an aggressive policy of merchandising were in effect, but on the whole, the local utility must be in the initiative if it is desired to build up a satisfactory load.

Where a municipality finds it worth while to be in the appliance business, the local Hydro Shop should be the leader among appliance stores not only to give impetus to sales but to instil confidence in the minds of the consumers and to encourage friendly competition with dealers for the general good.

*4. More Municipalities Should Engage in Merchandising.*

There are quite a number of Hydro municipalities in which it is quite feasible to operate an appliance store. In some of these it is also a necessity because of the meagre use now being made of Hydro service as well as the fact that there are no satisfactory appliance stores operated by dealers in existence. It would be unwise, of course, to advocate that every Hydro municipality should merchandise. In some of the smaller towns there would not be sufficient business to pay operating expenses and a loss is not justified. There are others, however, in which through the adoption of a proper active policy sufficient sales would be made to warrant the operation of such an establishment.

To accommodate a large number of smaller municipalities perhaps a travelling shop could be made use of. Were the Hydro-Electric Power Commission to outfit one or more properly designed trucks to travel from place to place conducting short campaigns for the sale of electrical appliances, it is believed the operation would be self sustaining. Such a travelling store could be preceded by lectures and cooking schools so as to have the population in a receptive frame of mind when the store arrives on the scene and sales which may be effected could be handled through the local system to avoid possible complications. Such a policy would obviate the necessity of renting premises the year round and of hiring a staff which would be busy only part of the time. It would also avoid the carrying of unnecessary stock for any length of time.

In various parts of the United States it is the practice of Power Companies to engage salesmen and distribute them among the dealers in

the various localities in which they operate. These salesmen are properly trained into Company methods and they are also thoroughly familiar with every possible use of electricity and the results which have attended such a policy of merchandising have been quite satisfactory. In many cases it has been shown without sales assistance by the Power Company the dealers have made no actual effort to sell the goods which would consume current. The sole object of a dealer seems to be to make a profit in the merchandise he sells whether it be electrical goods or something else. Articles which require a lot of selling demonstration and service are frowned upon in favour of other things which yield a good profit with little effort, and unfortunately, electrical appliances require a lot of selling and in order to do the job right, the Hydro should tackle it.

*5. Closer Co-operation with Dealers.*

For many years local Hydro systems and electrical dealers have gone their individual ways, ignoring one another in their activities and in their policies of merchandising. Very often friction has developed because of the methods employed by either. Hard feelings have resulted. Every electrical dealer is an asset to a local Hydro System because of the loads which he builds. Likewise, the local Hydro System is necessary to every dealer because of the help which it can give to increase his business, but there should be absolute co-operation between the two so that the difficulties of the past would be removed and it devolves upon the H.E.P.C. to formulate a policy of closer co-operation between these two elements. Such co-operation would eliminate unethical business practices, unfair competition through price cutting and would instil confidence in the industry.

*6. Hydro Shops should be on Self-Sustaining Basis.*

In order to avoid criticism every local Hydro Shop should be operated on a business basis. First of all, there should not be a Hydro Shop unless there is enough business to warrant it, but once its necessity has been established, it should be operated as though a private individual were the owner. The prime necessity is that a uniform standard system of accounting be installed in each Hydro Shop so that its operations can be properly accounted for. All reasonable expenses in connection with the operation of such a shop should be charged against it and an equitable portion of overhead expenses should be charged as well. Furthermore, the shop should receive credit or be charged with the results of operation; that is to say, surpluses or deficits from operation should be reflected in their separate balance sheets. Surpluses from such operations might easily be devoted to improvement in service. Deficits require treatment for their obliteration. Credit should be given Hydro Shops for the load building effect of their operations.

*7. Close Supervision of Hydro Shops.*

Because of the fact that there are a large number of Hydro Shops, it is necessary that uniformity of policy permeate them all. In order to insure that all Hydro Shops are operated satisfactorily, it would appear to be necessary to supervise their operations through some central bureau.

Such supervision would also have the effect of improving Hydro Shop operation by applying in one municipality the experiences of another. It would also be possible to adopt a plan of general advertising in which all would benefit.

*8. Sales Medium for Rural Customers.*

At the present time there are not many reliable and fully equipped electrical appliance depots where rural customers may be served. Rural customers are unfamiliar with electrical equipment and are often victims of over-zealous salesmen when they wish to make a purchase of some necessary farm appliance. By extending the travelling shop idea to include rural consumers the latter would be assured of sound advice, favourable prices, satisfactory equipment and prompt and proper service and by making use of the facilities provided by the rural power district Loans Act in the financing of electrical equipment for farm use purchases of appliances by rural users could be financed.

*9. Installing Adequate 3-Wire Services.*

For many years, large Public Utility Companies in Canada and the United States have recognized that there exists a barrier to the unlimited use of electricity in the homes of their domestic consumers. With the rapid development of electrical appliances, the potential field for the use of electricity is practically unlimited. Yet in many, many cases something stands between the consumer's desire and the electrical supply—an inadequate house service. The amount of electricity which can be used in the home may be limited by the size and type of the service entering the home.

In the early days of electrical distribution, lighting was the principal use made of electricity, but of recent years the consumption of current has been largely by appliances such as ranges, refrigerators, water-heaters and so on, the capacity of which demands heavy current carrying equipment and whereas the ordinary 2-wire service of years ago was adequate for lighting service, it now requires a heavier 3-wire service to do the job.

The cost of 3-wire services, or that of changing from 2-wire to 3-wire is usually borne by the customer as this service is considered part of the house wiring, but it is *this* cost which constitutes the barrier mentioned above. Many instances can be cited where sales of electric ranges and other equipment have been completed but when the question of adequate wiring arises and the cost is discussed, the sales are cancelled. Customers cannot appreciate the distinction between the services of various sizes and capacities. A local utility has for years followed the practice of extending its local distributing system from a pole nearest the customer's premises to some point thereon where the wires are attached to the consumer's wiring. Were the distribution system to continue down the wall into the house and through the service switch to the meter and if the cost of thus extending the service were borne by the local Utility, consumers would be relieved of this cost and at once the barrier to the unlimited use of electricity would be removed.

As most public utilities distributing electricity are at the present time concerned over the loss of load and recognize the stability of domestic use,

they have turned to face the problems hitherto preventing the development of this field and find the most formidable one to be that of the lack of an adequate house service. In a recent publication "Electric Light & Power", a survey was made of the electric range situation in the United States and Canada and it was found that among the 100 largest distributing companies, 54 have already adopted the policy of assisting customers to bear the cost or part of the cost of an adequate 3-wire service. Some of these Companies will instal a service of the proper capacity free of all charge to the customer. That is to say, they instal the service entrance cable, the necessary switch and range connections as well as connections to the existing house wiring, all free. Other companies bear part of this cost and the majority of them treat such expenditure as capital.

The present high cost of services is due to the lack of standardization. If these were to become part of a local distribution system more uniform methods would be applied in their erection and lower cost would result so that the burden on the utility would not be as great as it now is on the individual consumer.

It is estimated that services could be installed for from $20.00 up to $40.00, depending on the size, with an average of about $25.00 per service. There are about 350,000 domestic customers on the Hydro lines in Ontario who have not adequate services at the present time. Many of these represent tenants for whom landlords will not at the present time instal equipment to permit the use of ranges and other large appliances. Many of these are ready to purchase an electric range if the service were provided. A further large number would likewise purchase ranges if they did not have to pay for the cost of the service and if Hydro municipalities provide a service for all, the expenditure would not be more than nine million dollars. Spread over a period of years on a long term program this expenditure might well be considered a profitable investment.

If a service is installed free, naturally the utility would own the part of the service which it provides. This has its own peculiar advantages.

*10. Purchasing Existing 3-wire Services.*

As a publicly owned utility, the Hydro would be faced with many requests for recompense for the cost of services installed by consumers prior to the adoption of a policy of installing such services free and to be fair to these customers it may be deemed advisable to purchase outright such services as were installed and paid for by consumers up to a given time. Based upon estimated costs of installing services of various types and sizes, a value—a depreciated value—could be placed on each existing service and the consumer given an allowance equal to such value, such allowance to take the form of a credit to be applied against the purchase of a desirable current consuming device. This would have a two-fold effect. It would, first of all, automatically increase the number of electrical appliances in use, thus building up the load, and it would act as a great stimu-

lant to the electrical appliance business.

Supposing that the average inventory value of existing services is $10.00 and this were applied as a down payment on a refrigerator, range or oil burner or some other appliance, it is safe to assume the average value of these appliances would be at least $150.00 or 15 times the allowance. The total effect of purchasing 150,000 services would be to produce twenty-two and a half million dollars new appliance business.

These allowances could be made in the form of warrants which would be honoured by any dealer or Hydro Shop in each municipality and which would in turn be honoured by the local utility and paid for in cash upon submission of reliable evidence that the appliance or appliances purchased have been permanently installed.

Spread over a period of years, the policy of purchasing existing 3-wire services would not inflict a heavy financial hurden on any Hydro municipality.

*11. Each Municipality should Inaugurate a Service Department.*

Facilities for properly servicing electrical appliances in a great many Hydro municipalities are not of the best. Dealers come and go, models of equipment change, and when repairs are required they are costly. As a result, a large number of range elements, water-heaters, irons, toasters and the like are out of service and the local utility is, as a consequence, losing revenue and the system as a whole is suffering. Where there is natural gas competition it often requires very little selling effort to sell a gas stove or water heater to replace those operated by electricity if the appliances are in need of repairs and there is plenty of evidence to the effect that a large number of these devices have been replaced during recent years for this very reason. If each utility operated a service department of its own and inaugurated a system of inspection to ferret out and repair disabled appliances, not only would the latter come back into service but we would have more satisfied customers and additional load and revenue as well.

*12. Periodic Campaigns on Ranges and Refrigerators.*

Electric ranges and electric refrigerators are looked upon as seasonal appliances and special efforts are put forth by the manufacturers of each at various times of the year to increase their sales. Each Hydro municipality should assist in these campaigns as far as possible by promotional advertising and sales effort and the Hydro-Electric Power Commission could aid the municipalities and the manufacturers by similar effort.

*13. Impetus to H.E.P.C. Water-Heater Campaign.*

The success of the recently inaugurated H.E.P.C. Water-Heater Campaign has been assured but constant effort is necessary to keep before non-users of water-heaters the advantages of an adequate supply of hot water and the cheapness thereof under Hydro flat rates. It has been proven that customers do not come in suffi-

cient numbers of their own free will asking for a water-heater installation. In many municipalities to build a large water-heater load, continuous advertising and solicitation are needed if desirable results are to be achieved.

*14. Sales Budget or Quota.*

In order to keep ever before each local utility management the job that lies ahead, it would be advisable to set an objective in the matter of new appliances of the load building type to be added to the lines each year and impress upon each local commission the necessity for reaching this objective. This quota would have to be established by considering the requirements and possibilities of all municipalities jointly and severally at the beginning of each year.

*15. Organizing Hydro Employees.*

Every employee of each Hydro municipal system should be an enthusiastic booster for Hydro service. Each local commissioner should likewise be promoting the use of electricity among his constituents. One way in which to insure the right kind of enthusiasm is to see that every employee is making use of electric service for the major household operations where at all possible. There should be no excuse for any of them utilizing gas where electricity can serve unless, of course, the municipal gas plant is exerting its influence.

It should be the duty of all employees of the manufacturers of electrical equipment to familiarize themselves with the use of the appliances which their Company manufactures so as to become boosters for these products to their friends and others. Government records show that Ontario has 6,400 employees in publicly owned utilities. The electrical industry, exclusive of the utilities, employs over 10,000 people. Combining with these the local commissioners and councillors who administer Hydro affairs, we have an army of over 17,000 people who could be selling Hydro service every day of the year, and if their homes were properly equipped electrically they would be performing that function.

Surveys have been made from time to time to determine to what extent employees of Hydro utilities are making use of Hydro service and information gleaned from such surveys proves that we have a long way to go before we can expect Hydro employees to know enough about the use of electrical appliances to be boosters and salesmen for the service. Special inducements should be offered employees of the electrical industry in the purchase of electrical equipment which they require to insure complete electrification, and accurate knowledge in the use of electricity to make good salesmen out of this vast army. This done, it would not be a difficult task to organize these employees into a selling force that would do wonders.

*16. Facilities for Financing Purchases.*

In former years, electrical appliances have been sold in the main to people who could afford to buy. It is felt that the cream of the prospects for important appliances is now well equipped electrically. The people who are not yet users of electric service to a large extent are those with

little or no capital, those who live from day to day and whose budget does not permit of an outlay of a large sum of money at one time or month by month.

During the last two or three years there has been a tendency to stretch out the term over which payments for large electrical appliances are spread. There was a time when one year was considered long. A five-year term for such appliances as ranges and refrigerators is almost common-place to-day. To finance the purchase of an appliance over so long a period by ordinary finance methods through a private company is expensive; in fact, the expense is prohibitive, and many retailers find it impossible to carry customers' paper over so long a period. They haven't the capital nor facilities for so doing and it really devolves upon the local Hydro commissions to find a way to finance the purchase of appliances which mean load so that they can be paid for over periods which will be convenient to their customers.

*17. Lighting.*

In spite of the rapid advances which have been made in the art of illumination and the improvements which have attended the art of lamp manufacture, there is still room for much improvement in the lighting of the ordinary home. Inadequate lighting for reading, sewing and performing other household duties is injurious not only to the eyes but to the health, and the lighting industry has been for some time endeavouring to inject scientific methods of determining the correct amount of light to use for various purposes into the scheme of home economics. Where studies have been made of the correct amount of illumination for comfort it has been proven that the amount of light actually used is sometimes less than half of what it should be. Lamps of too small wattage are used sometimes to save current and expense but most frequently because of ignorance of what should be used or what is available and not until damage is done to the eyesight and to the health is this fact realized.

A tremendous load could be built by applying scientific methods to household illumination without overdoing it at all. Supposing all the consumers who have now an ordinary 40 or 60 watt lamp in the kitchen were to instal a kitchen unit, which they require, with a 100 watt or 150 watt lamp, it is within reason to believe that 350,000 customers would make the change and the result would be an increase of from 15,000 to 20,000 kilowatts of installed load. By applying the same principles to other parts of the home it would be reasonable to assume that from 200 to 500 watts of additional lighting capacity could be added without extravagance and this added load has its effect on the peak as well as on the consumption and produces comfort and health as well. Scientific information should be broadcast constantly to educate our consumers along proper illumination lines. This education should be carried to the schools and women's clubs and to other places where house-keeping problems are the subject of discussion.

*18. Sales Conventions.*

With campaigns for large appliances being carried on throughout the

Province almost continuously, with many new problems arising from day to day concerning the building of load through sales, sales conventions should be held at least once a year at which all sales problems would be thoroughly discussed and the experiences of various municipalities passed around. Heretofore, conventions of electrical men have been more concerned with engineering problems than those of sales and perhaps a great deal of good would be accomplished by devoting the major part of the time of a convention to load building and sales problems.

The electrical industry in the United States is highly organized and is alive to the possibilities of concentrated and co-operative sales effort. The experiences of all branches of the industry are from time to time brought out and discussed at national conventions and a great deal of information could be obtained by having one or more delegates attend such conventions.

*19. Encouragement to the Development of New Appliances.*

From time to time new appliances are placed on the market to perform new functions and the manufacturers of these appliances have a difficult time introducing them to the general public. The latter are unfamiliar with the importance of the new use. They are not aware of the cost of operation of the new appliance and perhaps they do not know the company which stands back of it. If a new appliance for a new use is introduced for sale it should receive as much backing from the electrical industry, particularly the Hydro municipalities and the Commission, as it is possible to give it so as to insure its rapid acceptance for load building purposes.

Of recent years appliances such as the coal blower, air conditioner, humidifier and others have appeared on the market but their acceptance is slow and while all of these things are a household necessity, customers are sceptical to purchase them for various reasons, chief of them being the lack of information.

*20. Municipal League for Adequate Wiring.*

For a number of years there has been in existence in Toronto what is known as "The Electric Service League." This league is supported by the Toronto Hydro-Electric System, the manufacturers of electrical equipment, jobbers, contractors and dealers and the chief object of the League is to promote adequate wiring among domestic users of electricity and to encourage the installation of as many electrical appliances as the home can use. A standard has been set up called "The Red Seal Standard of Wiring" under which new homes and homes to be rewired are equipped with facilities to make complete use of electricity. The effort to improve existing standards has been well worth while. There are thousands of new homes built during the last ten years which are much better equipped than they would otherwise have been and in these homes there are many more electrical appliances in use than one finds in the ordinary sub-standard home. To give an indication of the effect of organized effort to encourage

adequate wiring, the following table (Table No. 8) is submitted.

The cross-section census of new Red Seal houses recently occupied as compared with the same number of non-Red Seal homes confirms the great value of Red Seal work as the foundation of appliance sales, and equipment sales.

Many other such tables could be produced as evidence of the effect of co-operation. Were the municipalities of Ontario to band themselves together into a Provincial Service League, similar results could be pointed out in time and many of our load building problems would solve themselves.

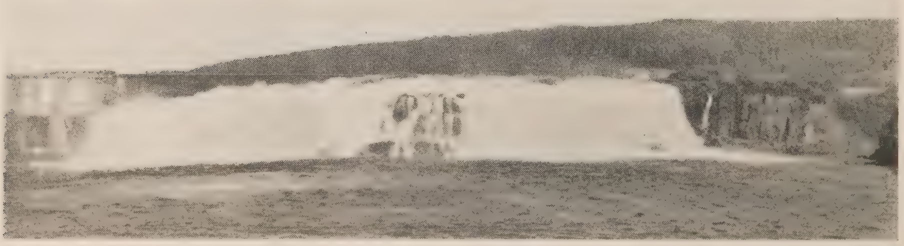
*21. Permanent Exhibit at the C.N.E.*

As the source of electrical energy in Ontario, and being looked upon as the fountain head of impartial knowledge regarding the use of electricity, the Hydro-Electric Power Commission should have a permanent exhibit of outstanding characteristics in the C.N.E

TABLE No. 8

APPLIANCE CENSUS SHOWS RED SEAL HOMES WELL EQUIPPED ELECTRICALLY

| | 100 Red Seal Homes | 100 Non-Red Seal Homes |
|---|---|---|
| Range | 90 | 12 |
| Refrigerator | 63 | 4 |
| Washer | 80 | 63 |
| Vacuum Cleaner | 89 | 58 |
| Ironer | 10 | 3 |
| Water-Heater | 80 | 13 |
| Grate | 35 | 20 |
| Floor Polisher | 27 | 9 |
| Sewing Machine | 27 | 10 |
| Iron | 100 | 100 |
| Toaster | 100 | 94 |
| Percolator | 83 | 27 |
| Fan | 15 | 5 |
| Electric Radio | 99 | 97 |
| Curling Iron | 32 | 29 |
| Port. Heater | 13 | 17 |
| Ventilating Fan | 17 | .. |
| Sun Lamp | 15 | 3 |
| Grill | 31 | 6 |
| Hot Plate | 24 | 8 |
| Waffle Iron | 15 | 6 |
| Blower | 15 | 7 |
| Oil Furnace | 11 | .. |
| Electric Clock | 73 | 31 |
| Floor and Table Lamps | 584 | 428 |
| TOTAL | 1728 | 1050 |



# Value of Home Lighting to the Public Utility

By Eleanor Potts, Home Lighting Specialist, The Solex Company, Limited, Toronto

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1935.)*

THERE lies in all of us that inherent quality which tells us to leave well enough alone, and so long as we think this attitude takes care of our requirements, very little is done by ourselves to improve conditions; but behind this apparent inactivity, nature takes a hand and by exacting penalties of varying degrees, she sooner or later forces upon us the necessity of searching for and devising a better means of accomplishing what we are trying to do.

In the matter of seeing, the human eye has been shamefully neglected, particularly so when we look at the situation within the home.

For many years we have accepted such improvements for home lighting as came along—were satisfied with them, but we forgot to question whether those stages of improvement represented adequate light for the tasks imposed upon the eyes in the work which had to be done.

Some twenty or twenty-five years ago scientists commenced delving into this important study and after making hundreds of thousands of surveys, learned that our present system of lighting was so inadequate, that impaired vision was so high in all ages of human beings that some drastic change was necessary. These investigations were so startling that I know the following figures will definitely impress you.

For instance, 20 per cent. of grade school children, 40 per cent. of the students leaving college and 95 per cent. of those reaching the age of 60, suffer from defective vision because of poor lighting; and as this is one of the penalties being exacted by nature, certainly we must do something to check this appalling waste of the human eye.

There are three elements involved in seeing—vision, task and light. Sight may be improved or aided by glasses—the task is definitely set by the nature of its order and offers little chance for change. Of these three, light is the one element which can be varied and in it we are most vitally interested.

Now consider this—to the central station, the sale of lamps has been precisely the same as sugar has been to the grocery man—something the householder will buy as and when the need arises and because of this feature, no attempt has been made to sell more lamps or lamps of higher wattage, so it is my ambition to impress upon you the importance of throwing the entire weight of your whole organization into this new "Better Light—Better Sight" sales approach, based on the crying need of eye conservation, so that through

it you will, by the shortest and most profitable route, reach a load increase that will be astonishing in its result.

---

How many of you know that in the domestic field, lighting yields the greatest revenue per dollar invested by the consumer, of all the appliances used in the home?

For example, using the year 1933, average kilowatt-hour rate of 1.67c. for domestic consumers, we find that the per dollar retail price of appliances produced the following annual revenues:

| Appliance | Average Retail Price | Est. Annual Consumption 1 hr. per day for 365 days kw-hr. | Est. Annual Revenue | Est. Revenue per dollar Retail Price of Appliance |
|---|---|---|---|---|
| 40w. lamp | $ .25 | 14.6 | $ .24 | $ .96 |
| 60w. " | .25 | 21.9 | .37 | 1.48 |
| 100w. " | .40 | 36.5 | .61 | 1.53 |
| 200w. " | 1.05 | 73.0 | 1.22 | 1.16 |

| Appliance | Average Retail Price | Est. Annual Consumption based on 3 kw-hr. per Day | Est. Annual Revenue | Est. Revenue per dollar Retail Price of Appliance |
|---|---|---|---|---|
| Electric Ranges | $125.00 | 1,095 | $18.28 | $ .15 |

| Appliance | Average Retail Price | Est. Annual Consumption kw-hr. | Est. Annual Revenue | Est. Annual Revenue per dollar Retail Price of App'ce |
|---|---|---|---|---|
| Irons | $ 5.20 | 72 | $1.20 | $ .23 |
| Toasters | 5.35 | 50 | .84 | .16 |
| Heaters | 7.85 | 40 | .67 | .09 |
| Percolators | 15.00 | 50 | .84 | .06 |
| Waffle Irons | 13.00 | 30 | .50 | .04 |
| Refrigerators | 300.00 | 440 | 7.35 | .03 |
| Ironers | 125.00 | 125 | 2.09 | .02 |
| Fans | 15.00 | 16 | .27 | .02 |
| Cleaners | 62.50 | 36 | .60 | .01 |
| Washing Machines | 125.00 | 24 | .40 | .003 |

Don't you find some startling revelations in those figures? You have seen that lighting in the home accomplishes—1st, load building; 2nd, profit; 3rd, and very important, the conservation of eye sight. Now how are we going to extract the most benefit to all concerned from this important field? Just one way, and that is by building up adequate lighting in the home.

In the "Better Light—Better Sight" movement, you have a device to accomplish what you are trying to do—build a load and give a service.

Remembering the fact that a great percentage of us suffer from defective vision due to poor lighting, let us go over to a review of what caused this condition.

Man was originally created to be a creature of the outdoors and had faculties designed to cope with that mode of living. During thousands of years the eyes were used under the natural conditions for which they were intended, viz:

1. Far distant seeing.
2. Under intensity of daylight.
3. During a day from sun-up to sun-down.
4. Doing tasks which were done at arm's length away from the eyes.

During the last hundred years, man has come indoors and completely reversed the conditions in that now we do:

1. Close work.
2. Intricate tasks.
3. Under very low intensities of light.
4. Use our eyes both day and night.

Sunlight produces intensities of 10,000 foot candles, and on a bright day in the shade of a tree, you have as high as 1,000 foot candles; in the shade of a porch, 500 foot candles; and inside the home, anywhere from 2 to 10 foot candles. Isn't it ridiculous for us to imagine that nature, which provides the high of 10,000 foot candle intensity, would not frown on our puny attempt to get along with 2 to 10 foot candles in the home?

Have you ever wondered why you feel as physically tired after a day at your desk as one of your linemen who has been climbing poles all day?

Poor lighting may have been wasting just as much of your energy as climbing poles would have.

Such abuse and waste of our energy should not be accepted. We know we need light to see! A little light, we see a little, with more light, we see more, and with better light, we see still better; by having adequate light we see easily and without the discomfort of eye strain, and this in turn aids our efficiency, safety and welfare.

To do any specified task in a bright light source, with the surrounding area of the room in comparative darkness, puts an unusually heavy strain on the muscles of the eye.

For example, how often do you read with a single ordinary lamp burning, with the remainder of the room in darkness? Your eyes glance away from the well lighted page into the part of the room which is unlighted, then back to the lighted page. What takes place? The eye muscles must readjust themselves with great speed every time this is repeated and the time you give them to do this is not sufficient to allow a natural adjustment, and results in

fatigue which affects the whole body. t

The research study of the "Ligh Sight Partnership" has resulted in the setting up of standards and specifications for the proper amount of light needed for different tasks. These specifications would not be at all practicable unless we had an easy, accurate way of measuring light, so it was necessary to borrow from the laboratory an instrument which is called the sight meter—this is it; small, compact and accurate.

This meter is composed of a sensitive photronic cell so delicate that the slightest light source striking it is converted into electrical energy which moves the needle along the scale that is divided into clearly defined sections marked in foot candles or degrees of light.

The printing above this scale indicates the minimum amount of light necessary for the normal eye to perform efficiently for certain given grades of work.

The first division marked 0-10 foot candles, tells you that those intensities are inadequate for critical seeing, and the next division, 10-20 foot candles, is required for reading normal print, and that for reading fine print or sewing, the need is 20 to 30 foot candles; moreover, that 30-50 foot candles is necessary for severe visual tasks over longer periods of time.

Bearing in mind that sunlight gives 10,000 foot candles and remembering also that the average home lighting intensities run from 2 to 10 foot candles, you have every reason to want one of these sight meter tests made in your own home. You will be surprised at the low figures under


which you and your family have been using your eyes, and so in almost every home the very same conditions exist and therein lies one of the greatest opportunities to capitalize an urgent need.

Let me give you a demonstration of these possibilities.

Quite recently in Toronto I was requested to visit a home in which both the husband and wife were complaining of insufficient light. I went there and found an average type of home, in the living room of which was the following lighting equipment (see diagram):

| | |
|---|---|
| A. Table Lamp on piano with 3 sockets, using 1-100w. which showed ¾ in. below shade . . . . . . . . . . . . . . . . . . | 100w. |
| B. Bridge Lamp behind chesterfield, 1-50w. lamp . . . . . | 50w. |
| C. Table Lamp, shade closed at top (should carry only 40w. lamp with safety). . . . | 25w. |
| D. Ornamental piece (3-25w. lamps exposed, not shaded) | 75w. |
| E. Lamp on table beside chair, 1-40w. lamp . . . . . . . . . . . . | 40w. |
| F. Table Lamp on high radio, 1-40w. lamp . . . . . . . . . . . . | 40w. |
| G. Two Brackets over mantel, 2-15w. colored lamps . . . . . | 30w. |
| Total . . . . . . . . . . | 360w. |

I relamped all fixtures with new bulbs and changed the position of some and added one of the new glass bowl reflector I.E.S. floor type lamps, using the three-way, 100-200-300w. bulbs and secured the following wattage results:

| | |
|---|---|
| C. was placed on the piano and used purely as an ornament | 40w. |
| N. new I.E.S. floor lamp with 1 three-way bulb, 300w. and 3-40w. lamps placed to light both the chesterfield and piano | 420w. |
| F. used to replace C beside chair, carries 75w. bulb, which is aided by bridge lamp N | 75w. |
| B. Bridge Lamp used beside desk | 100w. |
| E. Table Lamp remains in same position | 100w. |
| F. Placed on high radio because of dark lining in shade, 3-60w. bulbs | 180w. |
| G. Relamped with 2-25w. lamps, and shaded | 50w. |
| D. Placed on table to left of mantel | 75w. |
| Total | 1040w. |

Observe that from an original load of 360 watts in this average living room, it has been raised to a total of 1,040 watts, an increase of 680 watts, and in addition to this, sales were made of the following merchandise:

1 new I.E.S. floor lamp, 2 new shades for fixtures, 1 harp, and a complete new set of bulbs.

This, I think, gives you some idea of the hidden value which lies in better home lighting. Of course it must be said that the height of success depends upon the amount of co-operative effort put behind the merchandising of the idea of the "Better Light—Better Sight" movement.

With Hydro's facilities to coordinate the movement throughout the Province of Ontario, it should be a simple matter to add many thousands of kilowatt-hours' revenue to your present domestic load.

You can arrange a "Better Light—Better Sight" campaign that is flexible enough to meet the requirements of any locality with an organization practical enough to get an increased load right now and at a net profit too.

Thus you see that the advantage to the central station will accrue at a rate in direct proportion to the intelligence and determination of the effort made. Therefore, I cannot recommend an easier method of load building for profit than home lighting.

It has indeed been a pleasure to come to Toronto through the efforts of Mr. S. S. Bain of the Solex Company who pioneered, by actual commercial demonstration, the "Better Light—Better Sight" movement in Canada. I trust that each one of you will see the potentialities in this field—crack it wide open and go to it!

My best regards for your success.

# Expired Meter Record

By J. Ruff, Meter Installer, Brantford Hydro-Electric System

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1935)*

THIS paper covers expired meters only, and we have found, since installing this record, that it is a decided short cut to a definite end.

We have been using this system in Brantford for nearly two years, and find it to be very simple but efficient. Formerly the man changing expired meters received a list from the office, consisting of approximately 40 or 50 meters which were selected numerically as from 1200 to 1500, these being scattered all over the city. This meant much duplication, for on the next list would be addresses probably next door, or very close to those on the previous list, thus many miles were covered, and much time was consumed unnecessarily.

The basis of our present system is a five colour card record—that is, a separate colour for each year of expiration. Thus for all meters expiring in 1928 we use an orange card; those in 1929—white; 1930—pink; 1931—yellow, and 1932—blue. The cards are 5 in. by 3 in.

The city is divided into districts and each district numbered, as is also each street. At the top left hand corner of the card we set in the location of the meter, that is district, street and house number, as 7-4-176, and at the top right hand corner the Government inspection number, as 5124. Starting January 1st, in district No. 1 we simply select the expired meters from that particular colour of card designating that year, and finish street No. 1 which completes the work on that street for that year, and so on through the district.

Of course, as in all systems, this must be kept up to date. This is very simple, as all changes of meters made to-day are changed on the cards the following morning, this being effected by simply drawing a pen through the number of meter removed and writing in the number of meter installed. We are then through with that card for 5 years.

We keep this system in the Meter Department solely for use of that department, thereby not adding to Main Office detail. Information for the office records is supplied on a slip, showing meter installation and removal.

Improved efficiency by using such a record is shown as follows:—the gasoline consumption of the truck used in this work has been reduced by one-half; the time saved on expired meters amounts to 25 per cent.; ease of estimating what is ahead; simplified routine in office record changes; no expired list need be made and there is no hold-up on the list if the office is busy.

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave. Toronto

Subscription Price $2.00 Per Year


## Scientific Certainties and Economic Doubts


**By L. A. Hawkins, Executive Engineer, General Electric Research Laboratory, Schenectady, N.Y.**


*(Address to Association of Municipal Electrical Utilities, Ontario Municipal Electric Association and the Electric Club of Toronto, January 30, 1935).*

I SHOULD like to preface what I am about to try to say, by telling you something that happened in our laboratory some ten or twelve years ago. Dr. Whitney, who was then Director of our laboratory, had a letter from the state entymologist in Albany asking whether insects could live in vacuum. Dr. Whitney took this to one of our physicists, a very good man, and showed it to him and asked him if he would like to try the experiment. The man said no, certainly not, it was a waste of time, "Every one knows that life can't exist without oxygen". Dr. Whitney said, "Did you ever try it?" He said, "No, every one knows that!" Dr. Whitney said, "Turtles bury themselves in the mud and are covered with snow and ice all winter, and they don't get much oxygen, but in the summer they come up." "Oh," he said, "You mean hibernation." Dr. Whitney said, "I don't know what I mean, but do insects live in vacuum?"

He went to another man and got the same response. This time Dr. Whitney used another illustration. He said, "I have been told that you can freeze a gold-fish solid in a cake of ice and keep it for months and if you thaw it out carefully enough that gold-fish will be all right." The scientist said, "You mean suspended animation." Dr. Whitney said, "I don't know what I mean but I will try the experiment myself!" He tried it himself with the net result that after two hours in vacuum the insects came to life and were as good as ever.

Now that story illustrates a fallacy which is as old as human thought and which is still very, very common. It is shown by the fact that two pretty good scientists fell into it. That is the fallacy that when you have given a thing a name you have explained it.

## CONTENTS

**Vol. XXII** **No. 3**

**MARCH, 1935**



When Aristotle explained the falling of bodies by an inherent characteristic which he called heaviness it followed from that that the heavier a body was the faster it fell, and so great was the prestige of Aristotle's authority that that fallacy persisted for 1900 years until one day a young monk climbed the tower of Pisa carrying different weights. He dropped them simultaneously and the simultaneous thud of those two weights signalled the beginning of a new era, the era of modern science. It was Gallileo who was the first to teach and show that the way to question nature is by experiment. Observation is all right. Aristotle was a good observer, but most natural phenomona are too complicated to get more than a superficial knowledge through observation. It was necessary to break those phenomena down into elements by experiment and study them.

The world began to appreciate the effect of Gallileo's teaching, and science as we know it today began to develop, and as the realization of the significance of that teaching became better and better understood, that progress has constantly accelerated.

It is forty years since I began the study of physics and any physicist will agree that the advance that has been made in the fundamentals of this universe of ours during the last forty years is far greater than that in all the previous history of mankind. The interesting thing about it is that when I first studied physics, everything was known. Physicists said that all the fundamentals had been discovered, that little remained for physical experiment, except to carry figures to another decimal point, but as I look back on what I was taught forty years ago, I find that practically everything that I was taught about the fundamentals has either gone into discard or has been profoundly modified.

I don't wish to get too technical, but for the purpose of what I want to lead up to I want to illustrate that by a few technically important fundamentals. For instance when I studied physics we knew that matter was made up of atoms, which were indivisible, unchangeable and indestructible. Today we know that matter is made up of no such thing, but atoms are made up of building blocks of which we have discovered two in the last three years. We know that the atom instead of being unchangeable is, in some cases, spontaneously changing to different kinds of atoms and the physicist in his laboratory has been able to transmute many of the elements into different elements.

We knew then that radiant energy was a simple wave motion in the ether. Today we don't know whether there is an ether and we don't care, but we do know that radiation is no such simple thing as that. We knew forty years ago that the amount of matter and the amount of energy in the universe was each absolutely constant. Today we know that energy and matter are convertible one into the other. We know that the only reason that the sun is able to supply us with energy at the rate at which it is supplying us with and has been for millions of years is because matter is being radiated away at the rate of 4,000,000 tons per second. That means a good deal of energy, for the energy corresponding with one ounce of matter corresponds roughly to all the energy exerted by about sixty thousand men during their life time.

We knew forty years ago that space was a simple thing. The propositions of Euclid told us all about it. Time was another simple independent thing. Today we know that space and time don't exist separately but only in a space time continuum and we are far from sure that any such simple geometry as Euclid's tells the story. So I could go on, but I don't want to bore you with too many technicalities.

I have been telling up to now, some of the things we know aren't so. Perhaps it might be worth while to attempt a word or two about what we now believe is so in physics. I have just been reading the "Experiment in Autobiography" by H. G. Wells. I like it all the better because it is an experimental biography. In that, Wells expresses impatience with the modern physicist because he says that when the modern physicist attempts to talk about his present conceptions he utters a lot of nonsense. So Wells says in effect that he hasn't time to listen to him until the physicist develops a language that better fits his ideas. I think Wells is both right and wrong in that. First I will show you I think he is partly right.

Let's take the present conception of the two simplest things in the universe, the electron which we have known for some thirty-five years or more and its recently discovered brother the positron. If we ask the physicist for the picture or specification of the electron he will answer like this. "It is a train of waves or ripples." "Well, in what?" "Well in a sort of ether, but not the ether we were taught about forty years ago, but in a sub-ether which exists for mathematical purposes only." If you ask the nature of that ether you get the answer that it has the nature of a probability. So we have the definition of the electron as a train of waves in a non-existent probability. It is a little hard for some of us to picture.

The positron is just about as bad. If you want a picture of the positron, first you must take empty space, then you must make a hole in that empty space and that hole is a positron. So I think we can agree with Wells that when the physicist tries to put into words his present conceptions, the result is quite similar to nonsense. But I think Wells is wrong in expecting that the physicist is ever going to be able to express in terms of things in our every day life his present conceptions. In fact, we are all of us, so far as that goes, very much in the position of a boy just taking up the

study of algebra. He may want to know what are X, Y, and Z. Well, X is apples, Y is pears, and Z is peaches. That may help him for a while, but when he gets farther he knows that they can't always be apples, pears, and peaches, so finally he is satisfied to accept X, Y, and Z for what they are without reference to concrete objects. Now why should we assume that the more complicated mathematical functions of the present physicist can be represented by things we are accustomed to in our ordinary life any more than that boy should assume that apples, pears and peaches should represent algebraic functions. So in that sense I think that Wells is wrong.

But although we have had to abandon the mechanical models that used to be so dear to the physicist in the days when I studied physics, nevertheless physics today is approaching a mathematical development in which practically all of the phenomena we know of are comprehensively and consistently treated, and that new mathematical development is most fertile in suggesting new experiments which are leading with greater and greater rapidity to new fundamental discoveries. And although we don't know what they will be, we can be very sure that from those fundamental discoveries will come new things of practical value to us, just as impossible to predict today as radio broadcasting would have been fifty years ago.

Now I have tried to give some idea of the enormous progress that has been made in physical science during the last forty years, and some idea of the extent to which our conceptions of fundamentals have undergone a change. Now I think I can see certain resemblances and certain differences to that in what has been going on during the last forty years in the realm of economics. Now before I go on with the rest of my talk I want to profess an absolute lack of authority to speak as an economic expert. Years ago when Floyd Gibbons was broadcasting stories of our laboratory which he dubbed the "house of magic," he happened to refer to the impossibility of perpetual motion. For weeks after that broadcast we were deluged with letters from inventors who were sure they had discovered perpetual motion. One of these was so different that it aroused my interest. It was from a radio operator from eastern Massachusetts. He said, "I know I am a nut, but I have got a perpetual motion bug that has been biting me for a long time and I would be mighty grateful if you will kill it for me." I wrote him to send it along and when his letter came it wasn't hard to put one's finger on the fallacy, so I wrote explaining it. I got back an answer like this: "Say, I put the damned thing in the fire and it didn't even burn good, if you are down this way, come in and I will buy you a drink!" Now it is with all the diffidence of my perpetual motion friend that I venture into a discussion, even a superficial discussion, of economics.

H. G. Wells in his autobiography makes very clear the degree of unanimity with which the economists in the 90's, forty years ago, were satisfied with the existing order. He shows how only a small group of the intelligensia calling themselves the Fabians

were really vocal in trying to cast some doubt on the integrity of the system under which the world was then developing. I don't think that I need to enlarge on the doubts and the uncertainties which have arisen since then, particularly during the last five years, with people starving on one side and a surplus of food on the other; with factories idle, and people suffering for want of clothing and the other necessities of life. People have been forced to wonder whether there isn't something wrong. In fact we know there is something wrong, but when we come to ask what we can do about it, then we find that on every proposition, so called economic experts are in diametrical opposition.

I would like to ask the question whether this depression which we have been going through, and which we hope we are now emerging from, differs in any way from preceding depressions which we weathered in the past, beyond the fact of its greater severity. It seems to me that there is at least one important difference, resulting from the increasing development of the industrial or machine age. We know that today the portion of work that is done by machines in proportion to the amount done by human labor is greater than it was forty years ago, and it seems to me that the inevitable result of that is important. Whereas seventy-five or a hundred years ago it probably took nearly all the available labor to produce the necessities of life, today that is not so. A small fraction of the available labor, perhaps a third, is able with the help of machines to produce all that we need to live on and the rest of the labor that is employed is employed, if not on luxuries, at least on things that we can do without in case of need, which means that when the depression comes a greater number of men are likely to be thrown out of work than ever before. In other words the position of labor is more unstable.

In the same way the position of capital is also more unstable because of the same thing. Forty or fifty years ago in almost all industry, labor was the principle cost item. Today in many industries, labor has become a small item and the interest and depreciation on the plant have become of prime importance. That means that a manufacturer can not cut his costs by reducing output to the extent that he could forty years ago. So capital is in a more unstable position. That means that as greater instability develops, we must expect, unless something is done, that these swings of the business cycles will get worse and worse, more severe and more prolonged. We haven't reached the end of it.

Just as electric motors in the past forty years have taken most of the muscle work over from mankind, so in the forty years to come we are expecting new devices—electron tubes will take over many other jobs now performed by human effort. We have tubes today which will measure a millionth of a billionth of an ampere. Now to give you an idea of what that means, if you let the current through an ordinary 50 watt lamp be represented by the total flow of the Niagara River, the current this tube will measure would be represented by a trickle of one drop in five years. Speaking of electron tubes, I might

say just a word on a subject which many of you are interested in. That is this direct current transmission system described last week before the American Institute of Electrical Engineers in New York. The significance of that development I think may be summarized this way. By means of better and more powerful tubes and a better and more stable circuit, we have been able in the Schenectady Works to transmit by direct current about two hundred amperes at about fifteen thousand volts, taking the power from the 60 cycle line of the New York Power and Light Company, transmitting it by direct current and transforming it back to 60 cycles and feeding it to the system again. It could just as well have been fed into a system with different frequency. But the startling thing about it is the fact that with an ordinary small fuse, that line with tens of thousands of killowatts back of it, can be short circuited with no disturbance or damage to the tubes. We now expect to install that equipment or something like it on a short transmission between Mechanicville and Schenectady so as to get a service test on the equipment. We don't know what the life of the tubes is going to be, and we don't know what obstacles and troubles we may come to. We don't know the economics of the system. That depends on the tube's life and the number of auxiliaries, necessary to take care of the proper wave shape for instance. All that remains to be determined, but we have made a long step forward toward the super-power system that engineers have dreamed of since electron tubes became available. It will take many years of development before we can hope to enter the electron tube successfully in such an application.

But now to come back to my main theme. In this economic confusion, it is realized that something must be done. What are we going to do? We don't need to despair. We shouldn't need to worry, if more and more human labor is displaced by machines. I doubt if there ever was a time when life was richer and happier than it was in Athens at the height of its glory and at that time no Athenian worked. There were four slaves to every Athenian. They did all the work. Today we have forty slaves for every one of us—mechanical slaves. There is no reason why life shouldn't be ten times richer than it was at Athens. For after all, our standard of living depends on the amount of wealth we can produce. The greater the efficiency, the more the machines can do for us, the better off we will be when we learn how to take care of these swings.

Now the question I want to ask is whether the so-called science of political economy may not learn something from the physical sciences. Physical science began when it learned how to experiment, and its progress can be seen to be commensurate with the extent to which it was able to experiment. I know you can't put human beings in a test tube and you can't measure human needs with a galvanometer or weigh human institutions in a balance; but experimentation, wisely planned, under proper safeguards, and so arranged that the experiment can be called off if it proves unsuccessful, I believe is possible. The thing I like best about our present administration

in Washington is the frequency with which President Roosevelt uses the word experiment and the frankness with which he admits that the N.R.A. and these other alphabetical activities are experimental in their nature.

As long as they are so regarded, I am in favour of them all, because if they do fail, we will learn something from that failure, and if the loss of backing out and trying another experiment is not too great there will be a net profit. I firmly believe that our planned economy, planned with certainty, will become possible only when physical economy becomes a true science, and that the only way we can reach such a state is by experiment.

I had planned to stop here and perhaps I ought to, because I have talked too long and because if I go on I shall be straying further than ever from my proper field, but one piece of news in this morning's paper prompts me to say just a few words in addition. I mean the vote in the United States Senate yesterday which once again barred the United States from entrance to the World Court. That vote to me was a great disappointment. I think that no intelligent man to-day can shut his ears to the rumblings of international discontent which threatens once more to plunge the world into wide-spread war. Now if we are to find out how to allay these discontents, how to build up and establish firmly the means for arriving at and maintaining universal peace, many very difficult problems must be solved; and just as I believe that no political economist to-day can give us a sure program for arriving at and maintaining universal prosperity, so I believe no statesman to-day can give us a sure program for arriving at and maintaining universal peace. I think that experiment in both fields is necessary. I have spoken of the experiments at Washington in the economic field. I believe in the international field such experiments, if I may call them that, as the World Court and the League of Nations, must be made.

And to whom can we look for leadership? To whom can the world look for leadership in such experiments as the future may indicate as desirable? Of the seven great powers, only two enjoy relative immunity from military aggression, combined with economic self sufficiency in resources. Only those two are strong enough to afford to take a chance. Only those two are rich enough to afford to be generous. And I believe that the safety of the world can be reached only through the co-operation of those two powers, not merely for their mutual protection as in a military alliance, not merely for economic advantage as in a trade agreement, but in leadership along the difficult path towards permanent peace. I firmly believe that the ultimate hope of the world will rest on such co-operation between the two English speaking powers, the British Empire and the United States.

# Store and Window Lighting

By Geo. G. Cousins, Testing Engineer-in-Charge, Illumination Laboratory, H.E.P.C. of Ontario.

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 29, 1935).*

THE lighting problems of the merchant are different in several respects from those of other users of light. In the factory and office, the lighting is chiefly utilitarian and the manager decides how much intensity is necessary and those who have to make use of the illumination have no voice in the matter and must use what is provided. The retail merchant, however, decides how much he is to use, but the public to whom the merchant looks for patronage decides by their patronage whether or not the merchant's lighting appeals to them. In addition to all the utilitarian requirements, the merchant must recognize and provide for that most important attribute, advertising. The time has long since passed when the public was left to its own ideas as to what and when to buy, the passive merchant is a failure and of all the means available with which to interest people in his wares, light is one that cannot be neglected. A fine store, expensive furnishings and the best merchandise are useless without adequate illumination.

### Shop Windows

Various estimates of the value of show windows rate them at $50,000.00 to $150,000.00 a year depending upon the size of the business enterprise and its location in the shopping districts of a city. Show window display is advertising and the money expended upon equipping show windows should be considered as advertising expenditure. Consequently, the amount necessary for lighting is not fixed by utilitarian needs but by influences that effect the attracting power. These influences include the nature and brightness of the surrounding stores and the relative density of pedestrian traffic on the two sides of the street. The higher intensities of lighting are necessary where there are counter attractions.

Pedestrians are attracted by brightly lighted windows just as surely and just as unconsciously as moths are attracted by lights. Show window advertising is successful every time a person stops to view a display and the measure of success is the percentage of the passers that stop. By actual count, it has been found in one case that by increasing the lighting intensity from 15 to 100 ft. candles there was a 73 per cent. increase in the number of passers that stopped. The cost for power of this increased intensity under the average Hydro net rate for commercial power is about 1.9¢ per hour for 10 ft. of window. Fifteen ft. candles cannot be said to have attracting power while 100 ft. candles is obtained by the use of approximately 100 watts per foot and it is evident that this intensity has a fair degree of attracting power.

As a rough guide, it may be stated that 100 watts on 12 inch centres or

150 watts on 15 inch centres furnishes reasonably good illumination for ordinary purposes. The cost of power for such an installation at the average Hydro rate would be about 0.2¢ per ft. per hr. Anything less than 150 watts on 3 ft. centres is hardly worth considering. The Red-Seal standard calls for spacing not more than 15 inches and 150 to 500 watts, depending upon the window, for main streets, and 100 to 300 watts for secondary streets.

In addition to the regular window lighting units, provision should be made for window spot or flood lights and foot lights.

The reflections of the sky and street on the windows during the day is one of the serious hindrances to effective display of merchandise. On a bright day, reflections on the glass of objects in the streets may be one hundred times as bright as the goods on display in a well lighted window and, as a result, the display is difficult, if not impossible, to see. An awning may reduce the brightness of some of the reflections but the main part of the problem is to increase the brightness of the window interior by every possible means such as regular window lighting equipment, flood lights on the most important objects, foot lights and light background.

Window flood lights should be used as close as possible to the objects that they are to illuminate. By test, a 200 watt floodlight was found to produce an intensity of:

| | | | |
|---|---|---|---|
| 6,400 | ft. candles | at | 2 ft. |
| 1,000 | " | " | 4 " |
| 270 | " | " | 6 " |
| 48 | " | " | 10 " |

It is thus evident that at 10 ft. they possess practically no punch. It is possible to conceal them behind window furniture and so make use of the short projection distance and resulting high intensity.

Where the reflections are severe, it may be more practical and economical to flood light a few large objects or groups of small objects than to attempt to light up the entire window.

Figs. 1, 2 and 3 show a window equipped with three rows of 200 watt units spaced 12 inches apart. One row is sufficient for night-time display, but the three rows are necessary for overcoming daytime reflections. The power for the entire installation would cost about 25¢ per hour at average Hydro rates. This 25¢ per hour represents the difference between an expensive window that is useless for the display of goods during daylight hours and one that possesses decided advertising value. It is evident that not many sales would be required to pay for the power used in this window.

The daily newspaper is looked upon as the old reliable advertising medium and it cannot be neglected. However, it is time that some attention was paid to the relative costs of newspaper and show window advertising.

A full page in a daily paper will cost somewhere between $25.00 and $100.00 per day depending upon its circulation. Assume that $60.00 represents an approximation to the average. A merchant could light 75 ft. of show window with 200 watt lamps spaced 18 inches apart for seven hours per day for about seven weeks for the cost of one page of newspaper at $60.00. Can any other form of advertising equal this at so low a cost?

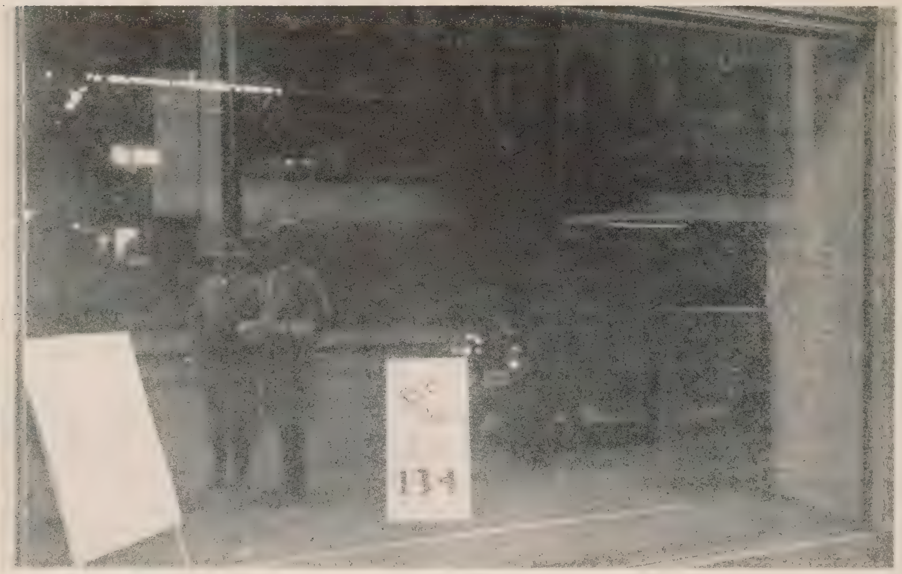



*Fig. 1—Overcoming daytime reflections in show windows. This picture shows a window without artificial lighting in daytime.*

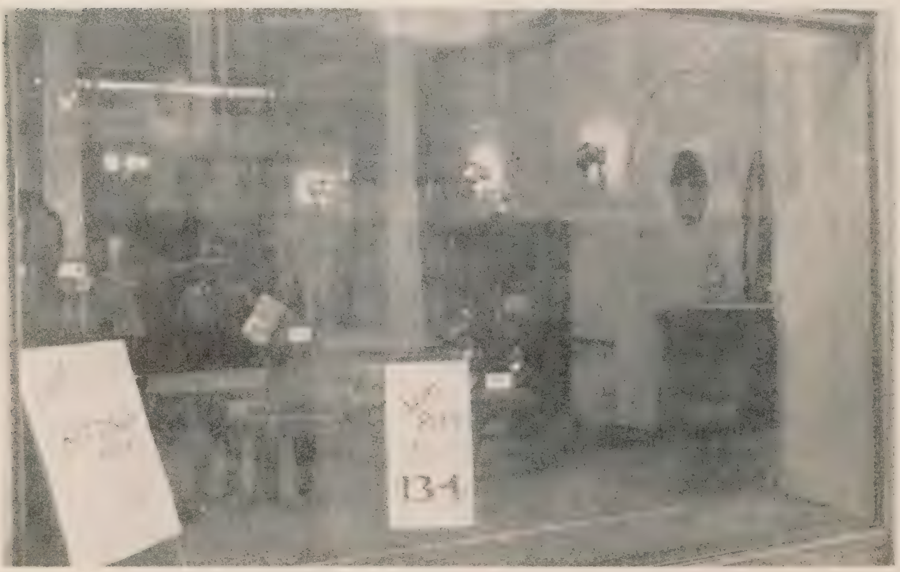



*Fig. 2—Same window as Fig. 1 as seen from the street under ordinary artificial lighting in daytime.*


*Fig. 3—Same window as Figs. 1 and 2, as seen from the street equipped with 3 rows of 200 watt units spaced 12 in. apart.*

### Store Lighting

Utilitarian lighting satisfies people who come in to buy, but to induce them to come in or to draw them to special displays of goods requires higher intensities. One store reported that each day three dress display racks were flood lighted and that, regardless of the style of dress displayed, more people were attracted to them and the sales far outnumbered those on other racks. This is a good example of what can be accomplished by the expenditure of a few cents per day for extra power. Power for three 500 watt flood lights for eight hours would cost only about 25¢. The profit on one or two sales would pay for the extra power.

In many stores there is what is called a dead line beyond which it is difficult to get people to go. If the illumination beyond the dead line is increased to a higher level than in the more active part, the dead line will disappear. Many times it has been proved that people are unconsciously drawn to brightly lighted areas.

Show cases also call for attention. Compared to no lighting in show cases, 35 ft. candles of artificial illumination increased their attracting power 130 per cent.

The very fact that people stop to look at goods is evidence that some sales resistance has been overcome. The clerk's first task is thus done for him or her.

Higher illumination intensity should always be provided where dark goods are displayed for sale.

In departments where goods depend upon sparkle or sheen for their attractiveness, direct lighting should be used whether or not indirect lighting is also

used, otherwise the beauty of the goods is lost. Such goods are silver, glass, jewels, silks and satins. For such departments, a combination of indirect and direct illumination or totally direct may be used.

Men's clothing is usually judged by their daylight appearance and blue bulb lamps will often reveal stripes and details of patterns that cannot be seen under unmodified light.

On a clear day, the illumination in the street may be about 10,000 ft. candles and inside a store, near the entrance, it may be only about 5, rarely more than 10, except in the larger stores. Such an enormous contrast naturally makes the store interior appear gloomy. Brilliant illumination just inside the entrance will ease the shock to some extent, but a common condition is to see a few small lights in the far interior that seem more to emphasize the gloom than to dispel it.

Why, in these days of cheap power and efficient lighting equipment, should a clerk precede a prospective customer to a dim section of a store and turn on a few lamps? Surely the proprietor of such a store is not familiar with the benefits of good lighting.

There is no substitute for good lighting. Any sales clerk who must carry his goods to a window or door to properly show them is advertising his employer's negligence or his failure to appreciate the value of the cheapest of all sales aids. No merchant would hand his customers smoked glasses through which to view his goods, but the effect of smoked glasses is exactly the same as insufficient illumination.

Sixty merchants were asked this question, "What has better lighting done for you?" Their answers, reduced to simplest form, are given here:

1. Better lighting adds attractiveness and value to even the best of merchandise.

2. Better lighting shows the true value of merchandise, thus reducing the returned goods problem.

3. Better lighting creates an atmosphere of cheerfulness which affects customers and clerks alike.

4. Better lighting instantly creates an impression of cleanliness, neatness and up-to-dateness upon even the least discriminating shoppers.

5. Better lighting overcomes competition by drawing trade from the poorly lighted stores.

6. Better lighting saves rent by enabling a store located in the middle of the block to compete with the corner store.

7. Better lighting makes it possible to use every foot of floor space and eliminate dingy corners.

8. Better lighting pays for itself many times over through the increased sales produced by it, for well-lighted merchandise is already half sold.

9. Better lighting doubles the attraction and sales power of window displays.

These are the opinions of merchants who speak from experience. The rates for Hydro power are so low that there should be no excuse for the false economy of stinting in the use of light. The task of those in authority and control of the many Hydro municipalities is to have faith in the effectiveness of good illumination and to

acquaint the merchants in their districts of its benefits. This can be most effectively accomplished by themselves setting examples in the lighting of their own premises. Start in to arouse interest at once so as to avoid loss during the fall shopping season. Most merchants postpone necessary improvements until it is too late in the season to reap the full benefit and often put it off until the following season.

# Report re Merchandising of Electrical Appliances by Hydro Municipalities

SEVERAL meetings were held to discuss the problem of future policy in connection with the merchandising of electrical appliances in Hydro municipalities and to answer the criticisms which have been raised against the alleged practices of so-called Hydro Shops, also to endeavour to lay out a plan whereby co-operation with dealers and contractors may be effected in the future.

In presenting the deliberations of this committee it wishes to emphasize the fact that merchandising activities are of vital importance to the future of Hydro in view of the present load building problems. It is also its desire to point out one of the fundamentals underlying Hydro development.

"Sir Adam Beck and those who first conceived the Hydro project did not think of facilities for delivering kilowatt-hours for less money than offered by existing agencies but rather thought of an aggressive public organization which would translate the potential energy of our great natural resources such as our waterfalls into comfort, conveniences and better living conditions in the home, the office and the factory."

Looking at the problem from the broadest point of view, it will be admitted as an axiom that every public movement has in mind the greatest good for the greatest number and it does not appear reasonable that much weight should be placed on the arguments of a few individuals who entered upon a business in recent years with their eyes open to the existing agency, especially since Hydro merchandising activities have been of great benefit to the consumers of Hydro.

Many of the criticisms which are levelled at Hydro merchandising practices really originated in the practices of the gas companies. These agencies will install gas ranges free, including service from the street in. They also service ranges free of charge and they were the originators of a five-year plan for the purchase of gas ranges at low interest rates with no down payment and they are known to have given excessive trade-in allowances on electric ranges to get them off Hydro lines.

The meetings considered in detail

the important criticisms which contractor-dealers have drawn to the attention of the Hydro-Electric Power Commission as relating to Hydro merchandising activities and these criticisms with explanations as approved by the delegates attending the meetings are presented below:

1. *Hydro municipalities should not merchandise.*

The answer to the oft repeated charge that Hydro municipalities should not merchandise is to be found in an editorial appearing in the *Electrical World*, June 3rd, 1933, which states as follows:

"This matter of merchandising policy involves a lot more than the mere questions of whether or not a power company should continue to sell appliances. The real issue is the future of domestic load in the community, and the possible income from residence customers for the next five years.

"If the general public was sold on the use of electric appliances for cooking, heating and labor saving the situation would take care of itself. The power company could just step out and end the whole argument with the dealer and the politician, and people could buy elsewhere. But that is not the case. For most families to-day use a flatiron, a vacuum cleaner and a few other appliances. The other appliances may be appealing to them, but are not considered important. So they don't buy them. Most power company men fail to realize this, however, because they themselves have so long considered the clothes washer, the refrigerator, the toaster, the range and other appliances essential articles of equipment for the modern home. Therefore, they have always underestimated the problem involved in marketing this equipment, on which the growth of domestic load depends.

"It is true that the public can buy the appliances from the department, hardware and furniture stores and the electrical dealer. But this line of merchandise is still in that early stage where people don't buy. *They must be sold.* These appliances must tease their way into the home to-day. They must be advertised, demonstrated and followed up. It is expensive pioneering that doesn't pay the dealer and he won't do it. He would rather let the business grow slowly and at less expense. He is not concerned with building load.

"The power company must follow one of three courses—it can aggressively sell appliances that increase residence consumption; it can quit merchandising itself and abandon all effort to build up domestic income, save as it slowly develops through increasing popular demand, or it can deliberately organize a co-operative relationship with local dealers that will gradually develop an adequate number of strong retailers, supported with such special services as only the power company can and should supply, since they are essentially designed to hasten the growth of load.

"Whether the utility will or will not merchandise in such a co-operative program will depend upon the local plan. It may or it may not. But the experience of several cities proves that it cannot quit without building up dealer sales to do the job. It is a process that requires

several years in development, however."

2. *Hydro Shops have exclusive selling rights for various makes of ranges, refrigerators, washers and so forth which dealers cannot purchase.*

For the most part the establishment of exclusive agencies by manufacturers of ranges, washing machines, refrigerators and the like is part of a recognized policy of all manufacturers of all kinds of equipment. Exclusive agencies have distinct advantages over the establishment of numerous re-sale depots especially in small municipalities or localities. The fact that Hydro Shops have exclusive agencies for some electrical appliances is attributable to the fact that when electrical appliances came on to the market there were few electrical dealers in existence. Hydro municipalities were pushing the sale of these appliances almost exclusively and the manufacturer naturally gravitated to these outlets to establish dealerships and where the sale by Hydro Shops has been satisfactory, the manufacturers have not cared to change their connections and, due to their policy of desiring exclusive agencies for their product, they have not chosen to establish other outlets where they deem it unwise to do so.

One excuse for the establishment of exclusive agencies with the Hydro by manufacturers is that the latter are assured receiving payment for the goods they sell. There are many instances of private dealers having exclusive agencies to which the Hydro Shops raise no objection whatever, and which the dealers do not mention.

3. *Hydro Shops are taking wiring away from contractors, particularly in connection with the Water Heater Campaign.*

On May 11th, 1934, a letter was sent out to all municipalities advising them of an increase in the amount of promotional fees paid for obtaining flat rate water heater contracts. It was suggested that a $4.00 promotion fee be given in part or in total to contractor-dealers where the latter were instrumental in securing contracts for water heaters. The plan which was suggested at the time was to pay the full $4.00 to established dealers, with showrooms, who would exhibit model water heater installations on their premises and would complete a sale of a water heater contract to a prospective consumer up to the point where it would be approved by the local utility and to pay at least $2.00 to licensed contractors who would perform part of that function.

In most municipalities the desires of the Commission are being met in this regard. The fact of the matter, however, is that the majority of water heater sales brought in to the Hydro by outside agencies are by carpet-bagger contractors and not by established dealers. It is also a fact that many water heaters have been poorly installed by contractors to the inconvenience of the local utility.

4. *Hydro has no concrete policy for merchandising.*

As a result of many conferences which were held throughout the years of Hydro existence a Hydro Shop policy was defined and in its most important features is being followed by Hydro Shops to-day.

An outline of this policy is given in the following:

(1) Hydro Shops should be established to promote the use of electric current by promoting the sale of all current consuming and load building appliances.

(2) They should conduct a continuous educational campaign.

(3) They should advertise and sell only the best Canadian made appliances to insure satisfaction and confidence in their use.

(4) They should refrain if possible from asking for exclusive agencies on appliances to the detriment of dealers.

(5) They should establish fair prices (manufacturers' resale) and maintain these prices except in the sale of shopworn, demonstration or out of date goods.

(6) They should set a standard for other electric shops to follow. The Hydro Shops should be a credit to the municipality and to the utility.

(7) They should foster a spirit of co-operation of dealers for the general good of the industry.

(8) They should follow up sales with demonstrations to insure proper and economical use of the appliances purchased.

(9) Hydro Shops should be placed on a self-sustaining basis. In determining the proportions of overhead which should be charged to Hydro Shops, credit should be given to the monetary value of the load created by Hydro Shop activities.

(10) A uniform system of accounting should be installed and accurate records kept to show when a shop is making money or losing it.

(11) A survey should be made to ascertain the number of appliances in use and records kept up to date if possible.

(12) A service department should be instituted to keep in constant touch with consumers with a view to keeping electrical appliances in a state of repair.

5. *There is no legal authority under which Hydro Shops are permitted to operate.*

Legal authority for the operation of Hydro Shops is contained in the Public Utilities Act, Section 17, which has been in force for many years. Since some appeared to have difficulty in comprehending what was meant the wording was made unmistakable by an amendment passed in 1934, in Section 17 of The Statute Law Amendment Act:

THE STATUTE LAW AMENDMENT ACT, 1934, CHAPTER 54, SECTION 17.

> "17. Subsection 1 of Section 17 of *The Public Utilities Act* is repealed and the following substituted therefor:
>
> (1) The corporation of any municipality may manufacture, procure, produce and supply for its own use and the use of the inhabitants of the municipality any public utility for any purpose for which the same may be used; and for such purposes may purchase, construct, improve, extend, maintain and operate any works which may be deemed requisite and may acquire any patent or other right for the manufacture, production or supply of any such public utility; and for any of the said purposes or for any purpose for which a public

utility may be used, may acquire by purchase or otherwise, fittings, fixtures, apparatus, appliances, machines, meters and other equipment and may supply or dispose of the same by sale, lease or otherwise and may provide for the installation and maintenance thereof in or upon the lands and premises of users of the public utility."

6. *Hydro Shops are operating at a loss.*

While quite a number of Hydro Shops have a separate accounting system to keep account of their merchandising activities, there are some municipalities where this is not done. Then again, the reports submitted by the former are not uniformly prepared and the distribution of accounts not consistent and it is not always possible to determine whether individual Hydro Shops are operating on a profitable basis or not. Over the period during which Hydro shops have operated there is little doubt that the merchandising activities of Hydro municipalities have been profitable. There are many cases in which the results of operation have provided sufficient funds to finance their entire future operations.

In considering the operating statements of Hydro Shops, it should be remembered that if a municipality operates a Hydro Shop a proportion of the overhead expenses which would otherwise have to be borne by the utility as a whole is defrayed by virtue of the Shop's existence. Proportions of salaries, rent and other overhead items are usually charged against merchandising activities.

7. *Hydro Shops frequently establish prices which cannot be approached by private merchants.*

So far as it is known Hydro Shops maintain manufacturers' resale prices on all new appliances which they sell. It may happen, of course, that some Hydro Shops handle goods the like of which other dealers do not handle and the prices on these particular goods may be lower than similar articles handled by others. The reverse might easily be true.

8. *Hydro Shops give long terms which private dealers cannot give.*

Long terms which Hydro Shops give, have been but recently inaugurated, perhaps on account of the publicity given to the proposed Hydro Range Campaign and also because of the tendency of finance companies to extend the terms on electric ranges and refrigerators. The general practice among Hydro municipalities has been to confine the period for the repayment of installments on appliance purchases to eighteen months but, as stated above, very recently, the periods have been extended.

The introduction of the meter plan of paying for refrigerators has further extended the term and the advantages of this plan over others apparently outweigh the disadvantage of the long terms. Many dealers are afforded the same privileges as Hydro Shops have in this regard.

As stated above, the Gas Companies were really responsible for the introduction of long terms for the sale of electrical appliances.

9. *Hydro Shops give excessive trade-in allowances.*

The trade-in allowance menace has long been a bone of contention among dealers and between the

dealers as a group and Hydro Shops and regardless of the facts one always will continue to accuse the other of unfair tactics.

The trade-in allowances which Hydro Shops give are on the whole no more excessive than those of other dealers, if they are as bad, but some uniform means of determining the trade-in value of an old appliance should be arrived at in each municipality to eliminate this trouble.

10. *Hydro Shops have facilities to collect installments through the medium of lighting bills.*

The facilities of Hydro Shops to collect installments through the medium of lighting bills is an advantage which cannot very well be shared with electrical dealers although, during a number of electric range campaigns, held during the past few months, customer's paper was purchased by the local utility from the dealers and the installments were thus collected through the lighting bills. In one municipality the process was reversed and facilities were given to the dealers to collect Hydro bills in their own stores along with the installments due by their own customers on the ranges they sold during the campaign.

The practice among a large number of Hydro Shops is to render separate bills for installments on appliances purchased. This is necessitated by the fact that bills for current are rendered every two months, whereas installments on appliances are billed monthly.

11. *Hydro Shops hold the weapon of power shut-offs over customers' heads to make them pay.*

The alleged policy of shutting off customer's power when he does not pay installments on appliances purchased is not one which is resorted to by Hydro Shops. Undoubtedly, the feeling exists in the consumer's mind that since an installment on the appliance appears on the lighting account when he pays one he must pay the other or his power will be shut off and perhaps occasions have occurred where the threat has been used but not applied.

12. *The Hydro Free Water Heater Policy is a forerunner of other such practices to increase the difficulties of competing merchants.*

There is no intention at the present time or in the near future to give away electrical appliances in a way similar to that by which water heaters have been installed during the past two years so that there need be no cause to worry on the part of dealers that the sale of other appliances will be hampered in any way by gifts from Hydro municipalities.

13. *Hydro Shops solicit lamp, fixture and other appliance business from time to time at very attractive prices.*

While Hydro Shops may have solicitors out, and there are very few of them, to sell electrical appliances, so far as we know there is no evidence that these appliances are being sold at less than standard resale prices. There are very few municipalities selling fixtures and no municipalities with representatives out selling lamps to householders. There have been cases where salesmen have represented themselves as Hydro salesmen selling inferior goods at low price before they were discovered. This may be the basis of the criticism.

14. *Dealers must pay taxes to pay Hydro Shop deficits.*

There is no known case where dealers or tax payers have been called upon to pay deficits resulting in the operation of Hydro Shops. It may safely be said that with perhaps one or two exceptions the profits which have resulted from the operation of Hydro Shops over the period of their existence have been more than sufficient to meet any deficits that may have resulted from the operation of these stores during periods of depression and low business volume. At any rate there never has been an increase in rates for electricity or a charge been put on the tax roll in any municipality to cover up deficits as alleged.

15. *Hydro Shops have outlived their usefulness; dealers can perform as good a job if left to their own resources.*

It is a well known fact and is proven by experience in the United States, where legislation was enacted to prevent public utilities from merchandising, that not only did the volume of business in the electrical appliance field diminish when merchandising was no longer indulged in by public utilities but what business there was gravitated to the mail order department stores rather than to the dealers who were left in the field by themselves; the business of dealers diminished. They lacked aggressiveness and knowledge and the advertising facilities necessary to make a complete success of promoting and selling a large volume of electric appliances. The result of the experiences across the line is that in most of the States where legislation was originally passed to prohibit the sale of appliances this legislation has been repealed and the public utilities have engaged in merchandising more vigorously than ever, but with more complete co-operation with the dealers.

In answer to the statement that dealers should be left alone in the field of electrical appliance selling, it may be pointed out that while the general impression prevails that we are close to the saturation point in domestic appliance use, the average annual consumption among domestic users in Ontario is but 133 kilowatt-hours per month as compared with a possible average of in the neighborhood of 1000 kilowatt-hours per month for an average home, so that the job of selling electrical appliances has not even begun and some vigorous effort must be put forth to start an appliance selling activity.

16. *Hydro Shops pay no business tax.*

Legislation provides that by local By-law Hydro Shops should be assessed as any other business in the municipality in which they are located and if business taxes are not now paid by Hydro Shops it is the fault of the municipality rather than the Hydro itself.

17. *It is wrong to compete with local merchants.*

The best answer to the complaint of dealers that the municipality should not compete with them lies in the fact that most of the Hydro Shops in operation in Ontario to-day commenced operations long before most of the dealers who are now complaining opened up their stores, and if looked upon in the right light, co-operatively and harmoniously,

dealers cannot fail to realize that a Hydro Shop is an asset to them rather than a detriment. Every live outlet for the sale of electrical appliances boosts the business for every other outlet providing he sells the right kind of appliances, services them properly and maintains his reputation for maintaining prices and fair dealing.

18. *Hydro municipalities service appliances at cost or free of cost, excluding dealers from this class of business.*

The question of supplying service at no profit, or at less than cost, or free is one which has bothered Hydro Managers for many years back. It is a well known fact that many electrical appliances have fallen into disuse because of the cost of repairs as experienced when these appliances were taken to unreliable places to be put into operating condition. Not only were the repairs poorly made but the cost was high. Local utilities are interested in the maintaining of consumer loads and as a means to that end must keep down the cost of repairing appliances. A great many utilities in the other parts of the world find it desirable and profitable to maintain appliances free of charge from a purely load maintaining standpoint and it is common practice also among gas companies to do the same thing.

The experience of municipalities faced with natural gas competition is to the effect that the high cost of repairs on electrical appliances has given the Gas Company salesmen a wonderful talking point in inducing Hydro customers to swing over to gas.

19. *Hydro municipalities use public money to compete with dealers.*

As stated in a previous paragraph, there are many cases in which the profits from the operation of Hydro Shops have provided funds to finance future operations of those establishments so that in reality these Hydro Shops are using the profits provided by the customers whom they are serving to finance their business activities and where this is not wholly the case it is partly true and if funds are not available from this source to finance the Inventories and Accounts Receivable, funds are borrowed from the Bank or from the local utility and the profits from the sale of appliances provide interest to pay for these funds, so that properly considered, the Hydro Shops do not use public money but money provided by their own customers to finance their operations.

20. *On account of Hydro merchandising and collecting methods private merchants find it difficult to collect their accounts.*

It is difficult to understand how or why Hydro collection methods should prevent private merchants from collecting their own accounts. If a sale has been properly made and agreement reached with a customer to pay a certain sum of money regularly he must have figured that it would cost something to collect the bill and it would require a system of follow-up to induce customers to pay when the bills fall due.

21. *Hydro Shops sell to friends and relatives of employees at reduced prices.*

The general practice among Hydro Shops is to sell employees electrical appliances at a reduced price, but

satisfactory evidence must be presented that the appliance is for the exclusive use of the employee or that it is to be a gift. Some municipalities require employees to sign documents to this effect.

* * * *

In all the arguments against utility merchandising, the electrical dealers carefully avoid mentioning the fact that privately owned gas companies have retail establishments of a very high order, and that they are continually carrying on a vigorous sales campaign to sell all kinds of gas appliances, without the co-operation of the dealers, and evidences are rampant of unfair business tactics by these gas appliance stores which far outstrip those of which Hydro Shops are wrongfully accused. The majority of the arguments against Hydro Shops could be applied to the gas company operations and could not be contradicted.

Some of the dealers have intimated that they might turn their efforts to selling gas appliances in preference to electrical appliances. If this comes to pass, there is little doubt but that other electrical appliance dealers will spring up to take their places, because with proper co-operation and vigorous sales effort there should be plenty of business for wide-awake, energetic dealers as well as Hydro Shops.

As the apparent cause for many of the criticisms which have been raised recently is the lack of proper co-operation with contractor-dealers, the committee considered a number of suggestions which are presented below and which are calculated to bring into harmony the dissenting factions in the electrical appliance selling field.

Careful consideration was given to each of the points included in these suggestions and they received the approval of the delegates to the meetings, the general feeling being that while the remedial concessions to dealers cover all of the causes for dissensions there are municipalities in which all of the remedies do not apply and it is expected that if contractor-dealers in a particular municipality are dissatisfied these suggestions be searched for the means to cure the local evil and the co-operative measures selected put into force.

*Suggestions for Co-operation:*

1. That the Hydro-Electric Power Commission in co-operation with the manufacturers and the municipalities carry on an advertising and educational campaign to promote the use of electrical appliances and in general local advertising local dealers be given mention.

2. That the promotional allowance paid to the local Hydro systems by the Hydro-Electric Power Commission for flat rate water heater contracts be given either in total or in part to contractor-dealers for securing contracts.

3. That where contractor-dealers secure such contracts they be given the job of installing water heaters.

4. That in any general load building campaigns which may be launched by the Hydro-Electric Power Commission or by local municipalities they be conducted in co-operation with dealers.

5. That each local utility consider providing means to assist dealers in financing consumers' purchases of

electrical appliances, possibly with the assistance of the Hydro-Electric Power Commission, with money at low interest rates and offering terms equal to those of the local Hydro Shop.

6. That Hydro Shops should not seek the exclusive franchise of any line of merchandise.

7. That price cutting should be avoided at all times.

8. That Hydro Shops offer to dealers any appliances for which they have the agency and which the dealers are not selling at as near the cost to the Hydro Shop as possible, providing they will sell at the regular retail prices.

9. That if there is to be co-operation there should be fair competition. Hydro salesmen should be prevented from any attempts to take electrical merchandise sales away from the dealers and vice versa.

10. That Hydro Shops should be prepared to assist the dealer to close his sales if necessary.

11. That while it is impossible to display every make of appliance on every Hydro Shop floor privileges should be granted to dealers to bring their customers into the Hydro Shop to help them sell their wares.

12. That an attempt should be made to establish a local basis for trade-in allowances on large appliances.

13. That Hydro municipalities should establish facilities where feasible to assist in educating all consumers in the use of appliances they buy after they have been installed.

14. That Hydro municipalities should furnish dealers from time to time with information on rates, the cost of operating appliances, new uses, etc.

15. That Hydro municipalities should furnish dealers with data on appliances in use, possible market and other information which would help them in their sales efforts.

16. That dealers should be kept informed as to which appliances are desirable as load builders and which are not, to suit local conditions.

17. That Hydro Shops should pay business tax.

18. That when a clear definition of what is an Electrical Dealer is obtained Hydro municipalities exert every effort to co-operate with local dealers along the lines adopted to meet local conditions and to further interests of the electrical industry.

19. Arrange meetings with local contractor dealers frequently to discuss local problems and if feasible become a member of contractor-dealer associations.

It is the concensus of opinion that something should be done to improve relations between contractor-dealers and Hydro municipalities because the Hydro Shops have a definite duty to perform and the sooner they can get at the job of increasing the use of appliances the sooner will their task be completed. If municipalities must stop every now and again to ward off attacks by contractor-dealers and others who have nothing but a selfish motive behind their movements not only will municipalities become discouraged in their efforts to build load but they will be seriously handicapped in planning campaigns which may be intended to benefit the entire electrical industry.

# Street and Highway Lighting and Their Load Building Possibilities

By G. F. Mudgett, Manager, Lighting Division, Canadian Westinghouse Company Limited, Hamilton

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1935)*

IN entering into a discussion of lighting regardless of its application, there are many aspects to be taken into consideration, but the two major aspects which affect us most directly and forcibly are those of safety and economic value. Thousands of accidents occur annually, in which lives are lost and millions of dollars are wasted simply because of inadequate illumination. We know that such a condition exists and that there is a very definite relationship between accidents and lighting, we know further that the tendency is for the situation to become worse. In our daily lives we are constantly gearing ourselves up to accomplish more and more in less time, we are working at higher pressures and travelling at greater speeds, with the result that the risk of accidents is becoming constantly greater.

The unfortunate part of the situation is that the application of lighting has not kept pace with progress made in the application of modern industrial and transportation methods. Manufacturing and transportation methods of 20 years ago would not be tolerated to-day and certainly under present economic conditions they could not survive. However, in spite of the vast improvement in the efficiencies of light sources and lighting equipment, we are, in the majority of cases, and certainly on the average, carrying on our activities under illumination at least 20 years behind the times. While it is quite true that in the case of street lighting there are more lighting units in use than there were 20 years ago, this is not an indication that there has been a marked improvement in street lighting conditions, and in this connection it is interesting to note that the average lamp used in the Province of Ontario for street lighting consumes less than 130 watts.

The question arises as to why the application of electrical energy for lighting has not kept pace with the application of energy for power and industrial purposes, and the answer seems to be that, to the average person, light is more or less an intangible element. Light is silent, it is not represented by physical shape or size and cannot be weighed and handled. Light is only a physical sensation transmitted to the brain through the eye. We are aware of the fact that light is an essential element when we are obliged to go about our tasks after dark, but we do not know the amount of light required to enable us to carry out a given task with maximum efficiency unless we experience some physical harm such as eye-strain,

or suffer a serious accident which may result in the loss of a limb or may even cause a death.

To the average person, the conversion of electrical energy to mechanical energy represents a much more tangible thing and the amount of energy required to perform a certain mechanical function can be definitely determined in advance, or, if not determined in advance, the user of the energy soon learns by experience that unless a certain amount of energy is used the required function cannot be performed. To sum the situation up, it appears that we cannot expect to bring up the use of electricity for lighting purposes to the level of electricity for power and industrial purposes until such a time as we educate the public to a better realization as to the physical and economic values of adequate lighting and prove beyond any question of doubt that the use of a certain minimum amount of energy for lighting is just as essential as a minimum amount of energy for a given power or industrial application.

As previously indicated, there exists a definite relationship between inadequate illumination and accidents; and while statistics are not readily available to show the economic losses in industry resulting from accidents, we have at our disposal considerable data relating to the annual economic loss in the Province of Ontario due to accidents on urban and rural streets and highways. We can also determine from these data the losses incurred which are directly attributable to inadequate illumination and an analysis of the figures shows very clearly that the public pays for adequate street lighting whether it gets it or not.

In the early days of street lighting the primary function was to provide a minimum of illumination to prevent undesirable characters from molesting the local citizens. To-day, the function has changed, primarily due to the automobile. Adequate street and highway lighting are required to make our streets and highways as convenient and safe by night as by day, safe not only from the standpoint of crime prevention, but also accident prevention. We can only bring the public to a greater realization of the value of street lighting in the prevention of accidents by constantly bringing before it the actual statistics as to the cost of street and highway lighting and accidents, and proving that money spent for adequate and well-planned lighting is the cheapest form of insurance against night accidents.

In analyzing the comparative cost of urban accidents and urban street lighting in Ontario for the year 1933, we find many facts which present the strongest arguments proving that on the average, the annual Ontario street lighting expenditure is far below the desirable economic point and that as a result the public is wasting a tremendous amount of money. Furthermore, if the money wasted on accidents due to inadequate lighting could be spent in proper street lighting, untold suffering would be eliminated and great human and physical waste could be avoided. In addition, we would have a worthy use for the millions of kilowatt-hours with which our province has been so lavishly endowed.

In considering the present status of street and highway lighting in the province of Ontario, we find that from a cost standpoint practically all lighting is considered as urban and that whatever highway lighting does exist is either negligible as compared to urban street lighting or is close enough to urban districts to be considered as urban street lighting. For this reason it is necessary to associate street lighting with the urban population of the province and highway lighting with the rural population.

The urban population of the province is slightly greater than 2,100,000 and according to records the annual street lighting expenditure is approximately $2,020,000.00, resulting in a figure of 94 cents per capita as the cost of street lighting to the urban population. Authentic records show that accidents which occur on urban streets of the province and which are directly attributable to inadequate street lighting cost the urban population more than $1,400,000.00, annually, or 67 cents per capita. From these figures it becomes evident that indirectly the urban population of the province pays $1.61 per capita for street lighting whether they get it or not.

From data compiled by casualty insurance companies and recognized street lighting authorities in the United States, as a result of exhaustive research on the cost of accidents attributable to inadequate street lighting, it has been determined that an expenditure of $2.50 per capita for street lighting is a desirable economic figure. In other words, for this expenditure streets can be made as convenient and safe by night as by day.

In comparing the street lighting and accident records of the United States and the province of Ontario, it is found that the percentage of accidents directly chargeable to inadequate street lighting does not vary more than one or two per cent. It is therefore reasonable to give some consideration to the established figure of $2.50 per capita. Further investigation shows, however, that this figure should be corrected for the difference in energy cost for street lighting, which appears to be about 20 per cent., and results in a figure of $2.32 per capita for the province of Ontario as the desirable street lighting expenditure.

Now, if we accept $2.32 as a desirable cost per capita, it indicates that if we can convince the public that by spending the annual cost of accidents attributable to inadequate street lighting for improved street lighting, or in other words, increasing the per capita cost of street lighting from 94 cents to $1.61 we can reduce the number of accidents chargeable to inadequate street lighting and the cost thereof by 70 per cent., we immediately open up a potential possibility of increasing the present street lighting load by 71 per cent.

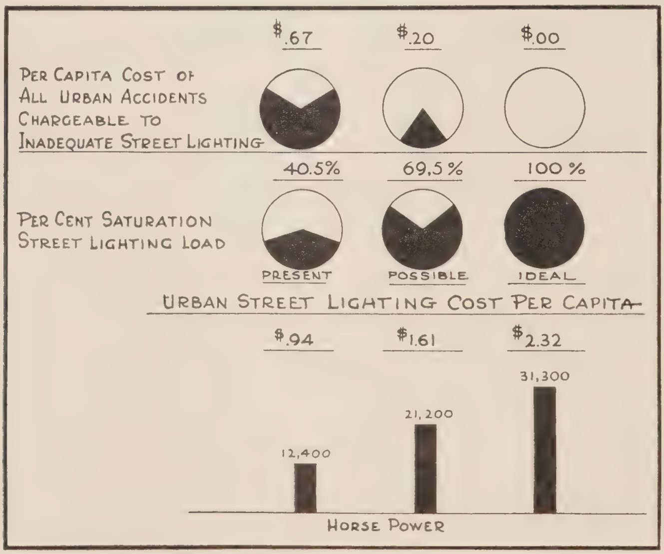
A reduction in accidents by 70 per cent. obviously would be a worthy achievement and would make any community a much better and happier place to live in, but why should we stop at that point when we know that by adequate lighting, streets can be made as safe by night as by day. Why not educate the public to a better appreciation of the value of street lighting and convince it that adequate lighting is just as

important to a community as adequate police and fire protection? It is not a difficult problem if presented in a logical manner and while it may never be solved completely, it is a definite obligation on the part of every one and the more nearly we approach perfection the greater will be the benefit to all.

To consider the question from the standpoint of an ideal situation, if we can convince the public as to the value of adequate street lighting in the prevention of accidents, if we can convince it that the expenditure for street lighting should be multiplied about 2½ times, and that such an expenditure would entirely eliminate all accidents chargeable to inadequate street lighting, we would further increase the potential possibility of increasing the present street lighting load to 200,000,000 kilowatt-hours annually or 147 per cent.

Any improvement in street lighting effectiveness is not necessarily brought about by an increased number of street lighting units installed, nor can street lighting be measured by the number of street lighting units. It is therefore not implied that by increasing the cost of street lighting a great number of units will be required or that elaborate equipment be used. We know definitely that in the vast majority of street lighting installations, regardless of locality, the effectiveness of these installations could be increased at least 4 to 5 times by the use of equipment of the most effective type in the most effective manner. This is a very direct indication that if the status of street lighting in the Province was improved to the most desirable point, the total number of street lighting units would not be increased and that the improvement would come about simply by improvements in effectiveness.

Improvements in effectiveness can be obtained by the use of larger but fewer lamps to replace existing small



lamps, and this replacement alone would result in an improvement of at least 25 per cent., suitable light controlling devices would in addition show an increase of more than 100 per cent., while proper attention to modern street lighting practice as set forth in the "Code of Street Lighting" of the Illuminating Engineering Society, would accomplish remarkable results. These factors coupled with proper operation and maintenance would most certainly show increases in effectiveness of 4 to 5 times in the average street lighting installation.

### Highway Lighting

So far this discussion has been confined principally to the question of urban street lighting as being separate and distinct from the question of highway lighting, the reason being that at the present time highway lighting is practically non-existant or at least negligible as compared to urban street lighting.

In view of this situation it is not possible to make an analysis of the problem in exactly the same manner as in the case of street lighting.

The fact still remains, however, that there is a very definite relationship between highway accidents and highway lighting or lack of it, and due to the almost complete lack of it we have a virgin field in which to develop an entirely new outlet for power. Furthermore, and as might be expected, a greater percentage of accidents chargeable to inadequate lighting, occur on rural highways than on urban streets. The Ontario statistics for the year 1933 show a total of 3,416 accidents on rural highways, 45.8 per cent. of which occurred in dusk or dark, and of these 40 per cent. were directly attributable to inadequate illumination or to glaring headlights which never will be the solution to the highway lighting problem. These accidents cost the people of Ontario a total of $1,083,000.00, and for this same expenditure a very material portion of the improved highways could be adequately lighted, and to a degree which would provide a condition of convenience and safety approaching daylight conditions.

On the basis of an annual rate of $30.00 per lighting unit which requires 250 watts, and assuming that 21 lighting units per mile would be required to provide adequate illumination, it would be possible to light 1,750 miles, or nearly 60 per cent. of the improved highways of the province. This 60 per cent. would probably take in those portions of the highway system which carry the greatest volume of traffic, and on which the greatest number of accidents occur. It is therefore reasonable to assume that if the important sections of highway in Ontario were properly lighted, at least 60 per cent. of all accidents attributable to inadequate lighting could be avoided, and in all probability at least 90 per cent. could be avoided.

To consider the matter from the standpoint of power consumption, one mile of lighted highway would require 21,000 kilowatt-hours per year, which represents 3.2 horsepower for every mile of properly lighted highway. Or if 1,750 miles of highways were properly lighted the annual power consumption would amount to

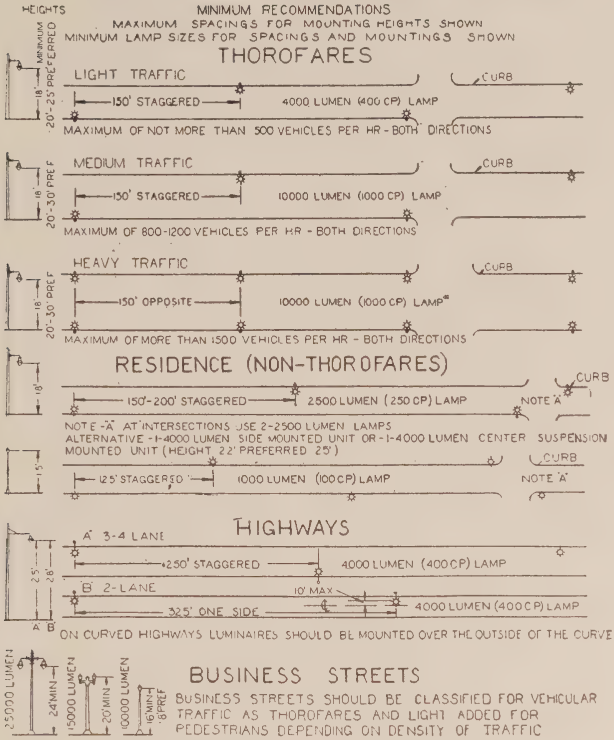
| | Annual Load kw-hr. | Horse-Power | Cost per Capita |
|---|---|---|---|
| Present Annual Street Lighting Load | 81,000,000 | 12,389 | $ .94 |
| Possible Annual Street Lighting Load | 138,680,000 | 21,200 | 1.61 |
| Possible Increase | 57,680,000 | 8,811 | .67 |
| Possible Highway Lighting Load | 36,750,000 | 5,600 | .79 |
| Possible Total Increase | 94,430,000 | 14,411 | |
| Possible Cost per Capita for Street and Highway Lighting | | | 2.40 |
| Present Street Lighting Load | 81,000,000 | 12,389 | $ .94 |
| Ideal Street Lighting Load | 200,000,000 | 30,300 | 2.32 |
| Ideal Increase | 119,000,000 | 17,911 | 1.38 |
| Possible Highway Lighting Load | 37,750,000 | 5,600 | .79 |
| Ideal and Possible Total Increase | 156,750,000 | 23,511 | |
| Total Cost per Capita for Street and Highway Lighting | | | 3.11 |

36,750,000 kilowatt-hours, representing about 5,600 horsepower, or about 45 per cent. of the present street lighting load.

In conclusion a few other already apparent and important facts in connection with the desirability of street and highway lighting might be briefly outlined. The cost of inadequate lighting has only been discussed from the standpoint of resulting accidents, chiefly because of the fact that statistics relating to accidents are the only accurate and reliable figures obtainable. We cannot overlook the fact that a great economic loss results due to crime which would not result if streets and highways were adequately lighted. If accurate statistics were available as to the cost of crime and its relationship to lighting, we could strengthen our argument for better lighting very materially, it therefore appears desirable that an investigation of this particular subject be made in the near future.

Another factor not to be overlooked is the competition of street lighting with other types of lighting, principally in business streets. In other words, improved street lighting results in improved store lighting and show window lighting as the effectiveness of such lighting is only measured by the contrast produced, and the greater the degree of contrast, the

# A Visualization of the Street Lighting Code of the Illuminating Engineering Society




greater will be the effectiveness. Good street lighting, just as good store lighting, brings business to a community and the travellers' or shoppers' impression of any community is often formed by the effectiveness of the street lighting. That business follows light has been proven over and over again.

A brief comparison of the value of the street lighting load and the load represented by a few familiar domestic appliances is of interest and shows the following:

The energy consumed by one 300 watt street lighting lamp burning 4,000 hours per year is equal to the energy consumed by any of the following:

30 Vacuum cleaners
45 Washing machines, 16 Irons
20 Toasters, 2 Refrigerators

Furthermore, both street and highway lighting loads have load factors of approximately 46 per cent. for a 4,000 hour schedule, whereas the average residential load factor is 20 per cent. or less in most cases, and since street and highway lighting loads are largely off peak, they can be handled without materially increasing the cost of station and distribution equipment.

It would be difficult to find a more desirable field than street and highway lighting, or one that offers greater potentialities for building electric load.

# Analysis of Domestic Consumers' Survey Recently Conducted

By D. B. McColl, Manager, Walkerville Hydro-Electric System

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1935).*

A few months ago the Hydro-Electric Commissions in the municipalities of Walkerville, East Windsor, Riverside, Tecumseh and St. Clair Beach, all of which Systems are operated by the Walkerville Hydro-Electric System, decided to make a complete survey of the consumers in each of these municipalities, so that the information obtained from the same would be available as a basis on which to plan a comprehensive future load building campaign, the immediate objects of the survey being briefly as follows:

1. To seal and inspect all meter and service connections so as to eliminate possibilities for loss of revenue.

2. To inspect and replace all defective or improper fuses, both main line and branch block.

3. To record the type and capacity of all consumers' services.

4. To record all appliances in use on each consumer's service.

5. To verify each consumer's name and address, ownership of property, etc.

6. To inspect consumers' appliances and equipment and to make any minor repairs necessary, free of charge, and to take orders for major service work, supplies, appliances or wiring required by the consumer, and to record any prospects for new appliances or equipment.

7. To record and adjust any complaints in connection with service to the consumers.

The survey was designed largely as a goodwill campaign and the results obtained so far have been most gratifying in this respect, as it has provided an opportunity of clearing up many little misunderstandings as regards policy and procedure, service, rates, etc., which through lack of a proper understanding have, no doubt, been irritating to a number of consumers. It, at the same time, has provided us with much valuable information as to the attitude and requirements of the consumers on which to plan our future activities.

Three members of our service staff and one member of our sales staff, all of whom have considerable service and wiring experience, were selected to carry out the work and were given a special ten day training course covering all phases of the campaign to properly fit them for the work, each being provided with a small kit bag in which to carry their tools, equipment, forms, catalogues, etc., and also a few samples of range burners, convenience plugs, etc., to show to the consumers, the total weight of which was approximately 20 lb.

These four men operate under the direct supervision of our regular home service supervisor who has had

**Walkerville Hydro-Electric System**
**Home Service Report**

DATE ______ 193__
Name and Address Correction if any
Number in Household
Owner [ ] Whom did you interview
Tenant [ ]

2 or 3 Wire Service | Size of Wire | Size of Box | Is Range Wiring Installed to Kitchen
2 or 3 Wire Meter | Meter Number | Were Meter and Connections O.K.

| | No. | Amps. | Type | No. | Amps. | Type | No. | Amps. | Type |
|---|---|---|---|---|---|---|---|---|---|
| Fuses Used | | | | | | | | | |

F. R.—W. H. Wattage | Type | Booster Wattage | Type
New Seals Installed on: Meter | Service Box | F.R. W. Htr. | Misc.

Type of Range in Use | Type of Water Htr. | Type of Fuel Used for Heating
Electric Washer | Vac. Cleaner | Percolator
Electric Refrigerator | Air Heater | Motor
Electric Ironer | Iron | Hot Plate
Curler | Toaster | Grill
Radio | Misc. | Misc.

Memo of Repairs Made:-

Complaints and Remarks:-

Service Order Received For

Purchase Order Rec'd For

Prospect For | Date
Is Customer Satisfied with our Service

Checked with Load Records, Meter Card and Meter Location Card | Inspector's Signature
Sale Checked and Prospects Noted by | Entered on Main Sheets By
Service Order Checked by |
Complaints Checked by | Approved By

*Fig. 1—Home service report form.*

many years experience in dealing with all phases of our consumers' problems, he being responsible for the general conduct of survey, including the checking and analyzing of each day's work and for following up any complaints which cannot be satisfactorily adjusted by the men themselves.

The Home Service Report Forms, (Fig. 1) are run through the addressograph in the office to stamp on the same the name and address of each consumer and are given to the men arranged according to street order number.

An advance notice to the customer, explaining the nature of the survey, (Fig. 2) is delivered to each consumer by the men themselves two or three days previous to the call, which we find eliminates much lost time in gaining entrance to the consumer's premises.

The survey was first commenced in the town of Riverside with a population of 5,125, having 1,088 domestic consumers, with an average monthly consumption of 134 kilowatt-hours, and an average bill of $2.86 during the year 1934, the domestic rate being 4.2c. for the first 55 kilowatt-hours consumed per month and 1.5c. for all remaining consumption less the usual prompt payment discount of 10 per cent. There is no service charge. This paper covers the results obtained from the survey of the first 1000 consumers covered.

Riverside, from a residential point of view can be considered as being an average Ontario town, having the usual proportion of better class and working men's homes with a considerable summer colony along the shore line of the Detroit River and

A. P. Green, CHAIRMAN
R. A. Farrow, MAYOR
W. R. Woollatt, COMMISSIONER
D. B. McColl, MANAGER

Walkerville Hydro-Electric System
102 WYANDOTTE ST.
Walkerville, Ontario

OPERATING SYSTEMS FOR

Dear Sir or Madam:-

The commodity which you buy from us is service. Its value to you cannot be considered by the amount on the meter bill, but by the comfort and convenience this service brings to you in the daily life of your home.

It is our aim to assist you in obtaining the utmost benefit from our service, so we are asking one of our Home Service Men to call on you personally within the next few days.

He is authorized and equipped to help you in any problems you may have respecting our Hydro Service. He will adjust any difficulties you may be having with your appliances or any complaints regarding the courtesy and service of our employees.

We have asked him, while calling on you, to make an inspection of your meter connections and to take a list of the appliances in your home. We desire this information for the purpose of compiling statistical information as to the total number of appliances in use on our system so that we may provide adequate capacity to take care of any demand for service which may occur.

We will greatly appreciate your granting him this interview, and discussing with him from your standpoint as a Hydro customer, any of your electrical problems.

Yours very truly,

WALKERVILLE HYDRO-ELECTRIC SYSTEM

D. B. McColl

DBM/C MANAGER

*Fig. 2—Advance notice to consumers.*

Lake St. Clair, except that the residences have practically all been constructed within the period of the past fifteen years and consequently have a much higher percentage of three wire services than will be found in the average Ontario town of this size, due largely to the continuous educational campaign for adequate wiring, which was conducted while the building was most active. The result of the survey is as follows:

### Consumers Service

| | |
|---|---|
| Number of consumers covered by the survey | 1,000 |
| Number of three-wire services with range wiring installed to the kitchen | 657 |
| Number of three wire services to the meter only | 29 |
| Number of two-wire services | 314 |

### Number of Appliances in Service

| | |
|---|---|
| Electric Ranges | 373 |
| Customer Owned Electric Water Heaters | 108 |
| Hydro Flat Rate Water Heaters. | 48 |
| Electric Washers | 625 |
| Electric Refrigerators | 123 |
| Electric Ironers | 36 |
| Electric Vacuum Cleaners | 278 |
| Radios | 737 |
| Electric Grates | 18 |
| Electric Irons | 956 |
| Electric Toasters | 505 |
| Electric Percolators | 35 |
| Electric Hotplates | 54 |
| Electric Grills | 37 |
| Electric Curling Irons | 111 |
| Electric Sewing Machines | 18 |
| Electric Mixing Machines | 15 |
| Electric Air Heaters | 126 |
| Miscellaneous Appliances, waffle irons, sun lamps, hair dryers, small motors, etc | 54 |

### Adjustments Made to the System's Equipment

| | |
|---|---|
| Repairs made to the System's services and equipment | 39 |
| Meters found in improper order, seals missing, etc. | 17 |
| Meters ordered changed for various reasons | 19 |
| Meters removed to stock from abandoned houses, etc. | 11 |
| Number of cases where fuses were replaced or re-arranged to conform to regulations | 375 |
| Number of seals installed | 3,462 |
| Number of warning tags installed on service boxes | 1,000 |

### Adjustments. Etc., Made for Consumers

| | |
|---|---|
| Number of consumers directly interviewed | 867 |
| Number of consumers not directly interviewed | 133 |
| Number of consumers for which minor service repairs were made free of charge | 93 |
| Major service orders taken for repairs to consumers' appliances, value $138.40 | 53 |

| | |
|---|---|
| Number of miscellaneous sales made, value $110.80 ......... | 62 |
| Number of consumers requiring service work, many of whom intimated they would have the same done at an early date | 61 |
| Number of prospects received for purchase of new appliances | 57 |
| Number of consumers reported as being still dissatisfied with their service for various reasons, now in process of adjustment ..................... | 17 |
| Number of wiring jobs referred to local wiring contractors .... | 12 |

Cost of Survey

| | |
|---|---|
| Main line and branch plug fuses replaced, (567) .............. | $ 23.52 |
| Miscellaneous material. | 1.68 |
| Meter Seals (3,462) .... | 91.91 |
| Printing and Stationery | 22.60 |
| Labour and Transportation ............... | 431.54 |
| Total Cost ..... | $571.25 |

| | | Cost per Consumer |
|---|---|---|
| Material and Printing Cost .............. | $139.71 | 13.97¢ |
| Labour and Transportation ............ | 431.54 | 43.15¢ |
| Total ......... | 571.25 | 57.12¢ |

| | |
|---|---|
| Average number of calls per man per day .................... | 16½ |

Space will not permit detailing all the results obtained from the survey. There is no doubt, however, that definite results were obtained on all seven of the objectives as outlined previously.

The effect of inspecting and checking all meters in the field within a short period of time provides results that cannot well be gained in any other way. The effect of contacting every consumer within a definite period of time also gives results not otherwise obtainable, and the goodwill engendered should be very beneficial, the results of which, no doubt, will be felt over a very considerable period of time.

From a load building standpoint, the survey, we believe, will prove very valuable. A conservative estimate of the sales possibilities which we believe can be accomplished by a well organized sales campaign extended over a period of a year, is as follows: (See Tables No. I and II).

The above estimated figures should give some indication as to the possibilities for increasing the sale of power on the Hydro Systems throughout the Province of Ontario with a total of over 500,000 consumers, if an aggressive load building campaign is undertaken, as it is a simple mathematical problem to multiply the above sales possibilities by 500, which would indicate a total increase in load of over 40,000 h.p. per year.

The figures also indicate to some extent the possibilities for substantially increasing business for the manufacturers of appliances, equipment, wiring supplies, etc., which should be an encouraging factor in enlisting their support and assistance in any general load building campaign undertaken.

TABLE NO. I

ESTIMATE OF APPLIANCE SALES POSSIBILITIES FROM A ONE YEAR CAMPAIGN

| Appliance | No. Now in Use | Replacement Sales | New Sales | Total Sales | Value |
|---|---|---|---|---|---|
| Ranges | 373 | 25 | 35 | 60 | $ 6,600.00 |
| Waterheaters (F.R.) | 156 | 11 | 39 | 50 | 1,750.00 |
| Washers | 625 | 43 | 27 | 70 | 6,300.00 |
| Refrigerators | 123 | .. | 40 | 40 | 8,000.00 |
| Ironers | 36 | .. | 10 | 10 | 1,250.00 |
| Vacuum Cleaners | 278 | 20 | 20 | 40 | 2,800.00 |
| Radios | 737 | 52 | 28 | 80 | 5,200.00 |
| Grates | 18 | .. | 5 | 5 | 125.00 |
| Irons | 956 | 66 | 14 | 80 | 300.00 |
| Toasters | 505 | 35 | 25 | 60 | 250.00 |
| Percolators | 35 | .. | 10 | 10 | 130.00 |
| Hotplates | 54 | .. | 5 | 5 | 50.00 |
| Grills | 37 | .. | 5 | 5 | 40.00 |
| Curling Irons | 111 | 8 | 22 | 30 | 50.00 |
| Sewing Machines | 18 | .. | 3 | 3 | 300.00 |
| Mixing Machines | 15 | .. | 15 | 15 | 300.00 |
| Air Heaters | 126 | .. | 25 | 25 | 125.00 |
| Miscellaneous appli'ces such as waffle irons, sun-lamps, hair dryers, small motors, etc. | 54 | .. | 10 | 10 | 100.00 |
| Totals | 4,257 | 260 | 338 | 598 | $33,670.00 |

## TABLE NO. II.

## ESTIMATED ANNUAL INCREASE IN REVENUE AND POWER COSTS

| Article | Estimated Number of New Sales | Estimated Effect on peak in kw. | | Estimated Annual kw-hr. | |
|---|---|---|---|---|---|
| | | Each | Total | Each | Total |
| Water Heaters F.R.Av.600w. | 39 | .500 | 19.500 | 4,000 | 156,000 |
| Ranges | 35 | .750 | 26.250 | 2,700 | 94,500 |
| Washers | 27 | .020 | .540 | 50 | 1,350 |
| Refrigerators | 40 | .150 | 6.000 | 800 | 32,000 |
| Ironers | 10 | .100 | 1.000 | 150 | 1,500 |
| Vacuum Cl'n'rs. | 20 | .020 | .400 | 48 | 960 |
| Radios | 28 | .020 | .560 | 120 | 3,360 |
| Grates | 5 | .200 | 1.000 | 360 | 1,800 |
| Irons | 14 | .040 | .560 | 80 | 1,120 |
| Toasters | 25 | .025 | .625 | 50 | 1,250 |
| Percolators | 10 | .010 | .100 | 20 | 200 |
| Hotplates | 5 | .300 | 1.500 | 500 | 2,500 |
| Grills | 5 | .066 | .330 | 90 | 450 |
| Curling Irons | 22 | .010 | .220 | 30 | 660 |
| Sewing M'ch'es. | 3 | .010 | .030 | 30 | 90 |
| Mixing M'ch'es. | 15 | .010 | .150 | 30 | 450 |
| Airheaters | 25 | .100 | 2.500 | 200 | 5,000 |
| Miscellaneous | 10 | .010 | .100 | 100 | 1,000 |
| Totals | 338 | 2.341 | 61.365 | 9,358 | 304,190 |

Less Flat rate kw-hr. as above ........ 156,000

Metered kw-hr. ........ 148,190

Estimated Revenue Increase:

Metered—148,190 kw-hr. at 1.6 ........ $2,371.04

Flat Rate—39 F/R Heaters at 2.42 per mo. . 1,123.20

$3,494.24

Power Costs—61.365 kw. $82\frac{1}{3}$ h.p. at $34.00 2,799.00

Difference ........ 695.24

# Industrial Load Building

By V. A. McKillop, Engineer, Public Utilities Commission, London

*(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1935)*

THE title of this paper represents in London at this time rather a desire than an accomplished fact, which will probably be the case to some extent for all time. It will therefore be impossible to point to a large number of successful installations with a "holier than thou" attitude and say "Go thou and do likewise". Rather, we are inclined to view our efforts as missionary work which may be slow in showing returns, for no doubt there are two classes of results to work for—tangible and intangible—and both very important. New load is highly satisfactory as representing quick profits; consumer good-will and understanding is an excellent long-term investment.

London has no power sales department; that is, no one devotes 100 per cent. of his time to that work. The Manager loses no opportunity to promote the cause when consumers call at his office. The engineer calls on consumers either at their request or otherwise when time permits. The latter type of call is usually made with some definite application of electricity in mind for that plant. This then leads to a general discussion of rates, service, or whatever may be uppermost in that consumer's thoughts. And it is believed in most cases the result of such a conversation is two-fold (1) a new idea for the use of electricity has been planted (2) a better understanding exists.

Obviously these interviews cover a wide diversity of industries; the subject may be ovens as used in the preparation of food either in a large plant such as Kellogg Toasted Corn Flakes Co., or in the small plant of a baker. It may be ovens or furnaces for use in metal work; or small amounts of process steam, or auxiliary space heating. There are still some steam engines to be replaced with electric drive to the advantage of both the consumer and utility. And probably one of the greater benefits that we can render industry is the supply of more and better light. For it is becoming recognized that very few places whether factory, store or home, are supplied with proper and adequate light. So considering the variety of applications for electricity which should be given a vast amount of study if they are to be properly explained to the consumers, and having in mind the available power which we are all anxious to sell, does it not appear reasonable that at least one full time power salesman should be employed even in the smaller cities. As an alternative, or possibly to supplement this arrangement, the Hydro-Electric Power Commission might consider a department composed of specialists in this work for consultation with municipal officials when required.

It may be of interest to include with these remarks brief references to some loads obtained recently in London.

A spice company was buying Hydro for the front part of the plant but in the rear there were d.c. motors supplied from a steam-driven generator. They would not be persuaded to substitute a.c. motors for d.c. but they did consent to use one in place of the steam engine. Now Hydro turns all the wheels in the plant though not in the most economical manner. They have been able to take advantage of diversity between the two parts of the plant. Additional revenue to the Commission amounts to about $500 per year.

A hotel was using "canned heat" in their warming ovens for room service. One strip heater in each oven effected a very nice saving and eliminated a hazard.

The Commission bought a 50 kw. electric steam generator for demonstration purposes. It was loaned to a company making gummed paper to supply steam to the rolls on which the paper is dried. Operating conditions were reported much better than with the coal-fired boiler but costs were out of line and it was removed after two month's trial.

The steam generator was also tried on night heating in a factory where an oil burner was the cause of difficulties during the nights last winter. It has, however, considerably overrun their day demand resulting in costs which will probably cause its removal. Both of these steam installations have been made by our own men at a small cost which the consumer agreed to pay.

A glass manufacturing company used its boiler in the winter for building heat and two processes; in the summer only for the processes. These were the distillation of about 150 gallons of water per day, and also warming two large table tops (22 ft. by 7 ft. each) on which mirrors are silvered. A large tank was placed in the basement with immersion heaters and insulation and connected to one table above. The heaters were controlled by a relay so that when an intermittently operated compressor was on, they were off, and vice versa. The results were very satisfactory. Immersion heaters were then placed in the still and the heat of condensation is recovered and is sufficient for the second table. Some of the water is distilled at night to improve the load factor. A transformer was bought and both light and power purchased on one meter. This arrangement is carried on the year through for additional revenue to the Commission of about $600.

A commercial range and 6 kw. water heater were installed in a restaurant. The latter has been entirely satisfactory but the former was a source of trouble during the entire year of operation. This was due to several factors; (1) faulty design in allowing grease to run in among the fuse blocks and also early breakage of top plates (2) antagonism of chef who had been using gas (3) large proportion of short orders for which electricity is not adapted according to many restaurant people.

The cooking and baking field constitutes a large market for electricity although it appears very difficult to open. It is probably a generally accepted fact that electricity gives good results and that the cost is reasonable; possibly we are wrong to continue our appeal along these lines

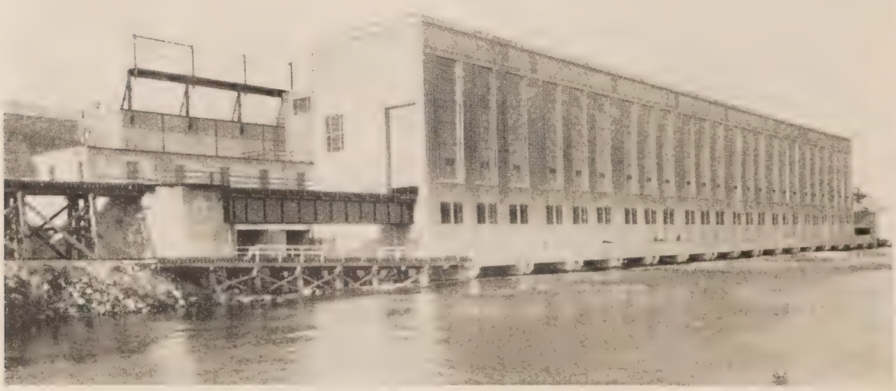
instead of stressing other advantages which are probably not so apparent. An article in the December 15, 1934, issue of the *Saturday Evening Post* tells of startling advance in sales of certain products through the use of "eye appeal", which suggests another method of approach to the commercial cooking market. The article explains that highly paid artists have been employed to assist engineers in developing products of pleasing appearances and convenient arrangement of parts. If appearance is so important to the public as the increased sales would indicate, then is it not proper to ask the manufacturers here whether due consideration has been given this matter. And secondly, does it not suggest that those restaurants and bake shops having suitable equipment might carry out part of their operations within the view of the public to their own advantage.

A planing mill has been using a steam engine although a very considerable amount of coal was bought to supplement the waste products under the boiler. A survey indicated that they should have 125 h.p. in 5 motors. For the present they have put in one 35 h.p. motor operating a fan and giving a revenue at the rate of $650 per year.

A hosiery mill required a small drying cabinet. Eight kw. were installed and proved very satisfactory and particularly economical because of diversity.

A small laundry was using a steam engine. A 15 h.p. motor was installed on trial and after about two weeks was bought by the consumer.

These examples do not represent large revenues; they are, though, a rather diversified list of applications. The conclusion is that uses for electricity may be found in unexpected places and even provide results which may give an agreeable surprise.



*Down-stream view of power house, Chats Falls Development.*

# Association of Municipal Electrical Utilities

## AUDITOR'S REPORT

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR YEAR ENDING DECEMBER 31ST, 1934.

### RECEIPTS

| | | |
|---|---|---|
| Cash in Bank, Dec. 31, 1933 | | $ 794.43 |
| Membership Fees: | | |
| Municipal | $1,371.00 | |
| Commercial | 360.00 | 1,731.00 |
| Convention Receipts: | | |
| January, 1934 | $1,450.50 | |
| June, 1934 | 946.00 | 2,396.50 |
| Donation from Ottawa Hydro | | 250.00 |
| O.M.E.A. Contribution (January) | | 121.00 |
| Interest on Bonds: | | |
| $1000 Prov. 5% | $50.00 | |
| $500 Dom. 4½% | 22.50 | |
| Talons Dom. 1% | 5.00 | |
| | $77.50 | |
| Int. on Deposits | 20.76 | 98.26 |
| | | $5,391.19 |

### ASSETS

| | | |
|---|---|---|
| Cash in Bank | | $ 665.84 |
| Dominion 4½% 1959 Bond | | 500.00 |
| Province of Ont., 5% 1948 Bond | | 1,000.00 |
| Account Receivable, O.M.E.A. (June Convention) | | 164.08 |
| Projecting Machine Cost | $243.45 | |
| Deduct for Depreciation | 218.45 | 25.00 |
| | | $25,34.92 |

### DISBURSEMENTS

| | |
|---|---|
| Convention Expenses: | |
| Dinners and Luncheons | $2,328.00 |
| Entertainment | 763.49 |
| Reporting | 83.80 |
| Printing | 306.12 |
| Badges | 178.35 |
| Sundry Expenses | 44.70 |
| | $3,704.46 |
| Travelling Expenses | 530.90 |
| Remuneration, Secretary | 150.00 |
| " Treasurer | 125.00 |
| Printing | 129.79 |
| Bank Exchange | 22.78 |
| Postage and Phone | 62.42 |
| | $4,725.35 |
| Balance in Bank, December 31st, 1934 | 665.84 |
| | $5,391.19 |

We certify that the above statements disclose the true condition of affairs of the Association as shown by the books and vouchers covering the year ending December 31st, 1934.

(Sgd.) W. G. PIERDON,
H. P. L. HILLMAN,
*Auditors.*

## Officers and Committees for 1935

Officers of the Association of Municipal Electrical Utilities for the year 1935, elected during the Convention at Toronto on January 29 and 30 are as follows:—

PRESIDENT—O. M. Perry, Windsor.

VICE-PRESIDENT—C. A. Walters,

SECRETARY—S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

TREASURER — D. J. McAuley, H.E.P.C. of Ontario, Toronto.

DIRECTORS (from the membership at large)—E. V. Buchanan, London; D. B. McColl, Walkerville and O. H. Scott, Belleville.

DISTRICT DIRECTORS:

NIAGARA DISTRICT—H. F. Shearer, Welland.

CENTRAL DISTRICT—C. E. Chase, Bowmanville.

GEORGIAN BAY DISTRICT—C. E. Brown, Meaford.

EASTERN DISTRICT—A. L. Farquharson, Brockville.

NORTHERN DISTRICT—T. W. Brackinreid, Port Arthur.

The following were appointed committee members by the Executive at its meeting on January 29.

PAPERS COMMITTEE—E. V. Buchanan, London, *Chairman*; G. F. Dean, Toronto; A. S. Edgar, Canadian General Electric Company, Toronto; C. W. Hookway, Canadian Westinghouse Company, Toronto; and H. D. Rothwell, H.E.P.C. of Ontario, Toronto.

CONVENTION COMMITTEE—C. A. Walters, Napanee, *Chairman*; W. R. Catton, Brantford; J. E. B. Phelps, Sarnia; C. C. Folger, Kingston; F. Mahoney, Canadian General Electric Company, Toronto; C. H. Hopper, Ferranti Electric Company, Toronto; G. F. Drewry, J. W. Purcell, and B. Mulholland, H.E.P.C. of Ontario, Toronto.

REGULATIONS AND STANDARDS COMMITTEE—H. F. Shearer, Welland, *Chairman*; W. J. Jackson, London; F. W. Peasnell, Toronto; R. J. Smith, Perth; R. L. Dobbin, Peterborough; J. R. McLinden, Owen Sound; J. Eckersley, Toronto; W. P. Dobson, H.E.P.C. of Ontario and A. G. Hall, Electrical Inspection Department, Toronto.

COMMITTEE ON ACCIDENT PREVENTION AND HEALTH PROMOTION—A. L. Farquharson, Brockville, *Chairman*; C. E. Schwenger, Toronto; V. A. McKillop, London; F. D. Hubbell, Windsor; J. R. McLinden, Owen Sound; J. W. Peart, St. Thomas; R. L. Dobbin, Peterborough; R. S. Reynolds, Chatham; R. Harrison, Scarborough Township, T. C. James, G. F. Drewry, E. R. Lawler and Wills Maclachlan, H.E.P.C. of Ontario.

MERCHANDISING COMMITTEE—O. H. Scott, Belleville, *Chairman*; J. E. B. Phelps, Sarnia; F. S. Rhoads, Windsor; W. H. Childs, Hamilton; I. N. Pritchard, Chatham; H. R. Hatcher, Galt; A. W. J. Stewart, Toronto; and G. J. Mickler, H.E.P.C. of Ontario, Toronto.

RATES COMMITTEE—G. E. Chase, Bowmanville, *Chairman*; W. H. Childs, Hamilton; P. B. Yates, St. Catharines; C. E. Schwenger, Toronto; J. W. Peart, St. Thomas; E. V. Buchanan, London; O. H. Scott, Belleville; O. M. Perry, Windsor; M. W. Rogers, Carleton Place; W. R. Catton, Brantford, and S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

COMMITTEE ON ACCOUNTING AND OFFICE ADMINISTRATION—D. B. McColl, Walkerville, *Chairman*; George Appleton, Toronto, *Vice-Chairman*; W. H. Childs, Hamilton; T. W. Houtby, Welland; J. W. Bayliss, Niagara Falls; A. B. Manson, Stratford; I. N. Pritchard, Chatham; W. E. Wallace, Windsor; R. S. King, Midland; M. W. Rogers, Carleton Place; H. Clegg, Peterborough; A. D. Nelson, Kingston; G. F. Shreve, Oshawa; G. F. Drewry, W. G. Hanna and R. M. Bond, H.E.P.C. of Ontario, Toronto.

AUDITORS—Messrs. H. P. L. Hillman, Toronto, and W. G. Pierdon, H.E.P.C. of Ontario.

It was decided to hold the summer convention at Bigwin Inn, on July 4, 5 and 6, 1935.

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year


## Hydro Lighting School

THE Hydro-Electric Power Commission of Ontario sponsored a School of Lighting at the Royal York Hotel in Toronto during the four days of March 12th to 15th, 1935. The school was conducted by lighting experts from the General Electric Lighting Institute at Nela Park, Cleveland, Ohio, assisted by the Lighting Division of the Canadian General Electric Company and by The Solex Company. The purpose of the course was to educate employees of the Hydro electrical utilities and those in the electrical industry as a whole, in the principles of better lighting and to enable them the better to sell it.

The instruction covered the explanation of common lighting definitions, and the method and equipment to be used so as to give adequate and well designed lighting in the home, the store, the office, the school and the factory. This took the form of lectures and demonstrations which were given under the following titles:

Introductory Remarks.

Dollars and Sense in Lighting.

What Every Lighting Salesman Should Know.

The Science of Seeing.

Seeing Goes to Work in Industry.

Why the Merchant Should Buy.

Selling Seeing in Schools, Offices and Drafting Rooms.

Lamps and Their Characteristics.

Cost of Light, Economics, Voltage and Wiring.

Recent Developments—Incandescent and Gaseous Conductor Lamps.

Control of Light—Materials and Equipment.

Fundamentals of Illumination.

Lighting Calculations and Layouts.

What the Merchant Should Buy.

The New Approach to Commercial Lighting Sales.

New Frontiers in Lighting.

Home Lighting Representative Calls on Mrs. Homemaker.

Applying the Science of Seeing in the Home.

What is New in Portable Lamps.

The Selection and Placing of Portable Lamps.

Lighting Fixtures for the Home.

Canadian Lighting Fixtures.

Typical Home Lighting Problems and Their Solutions.

## CONTENTS

**Vol. XXII** **No. 4**

**APRIL, 1935**



A Complete Home Lighting Demonstration.

Meaning of the New Approach to You.

The Light Brigade.

Concluding Remarks.

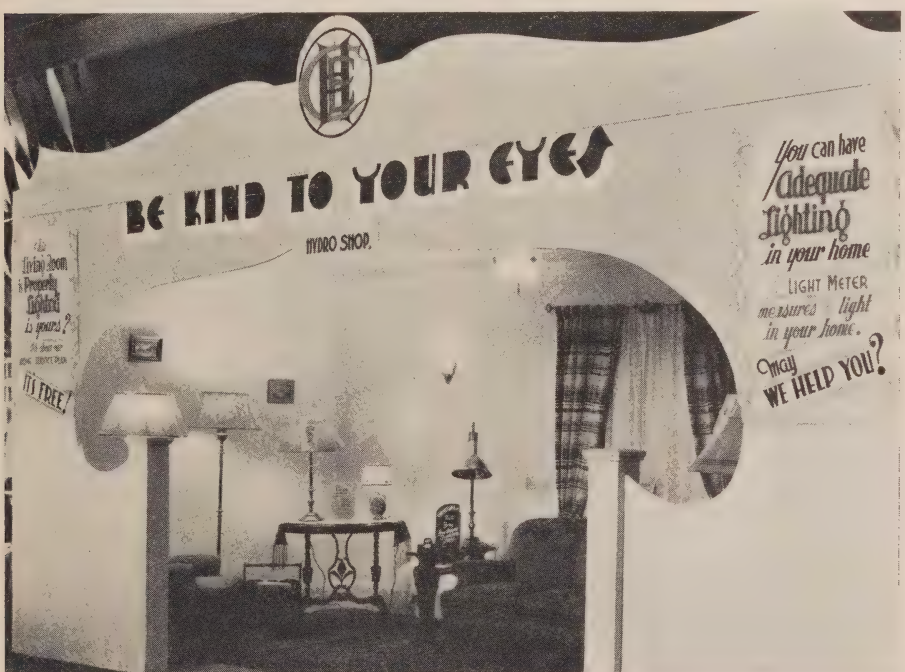
The school was opened by T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario, who in an address welcomed the lecturers and students. He complimented those who had charge of the arrangements on the preparations that had been made and was very pleased with the response to the invitations to attend, as shown by the number present, which was far in excess of what had been anticipated. He gave a note of inspiration to the assembly when he drew a comparison between lighting in the home when he was a boy and that being accomplished by present day methods. Ontario Hydro utilities supplied the chairmen for the different sessions, the following acting in that capacity:


*Chatham P.U.C. Lighting Booth at Rotary Fair.*

Messrs. O. M. Perry, Windsor; O. H. Scott, Belleville; A. W. J. Stewart, Toronto; W. H. Childs, Hamilton; T. R. C. Flint, Toronto, and J. W. Peart, St. Thomas.

In addition to the regular sessions of the school, which were held during the mornings and afternoons, there were two public evening sessions. One of these evening sessions was open to architects, optometrists, dealers and the electrical industry in general, when lectures were given on "The New Science of Seeing" and on "Applications of the New Science of Seeing". The other evening session was open to ladies and to the general public. At this session "Home Lighting" was discussed and a troupe from the Border Cities Hydro utilities produced a playlet entitled "Eyes Right", which gave a vivid picture of the need of proper lighting in the home and the method of obtaining it.

As most of the lectures were in the form of demonstrations they cannot be published to advantage. The substance of those lectures and demonstrations, however, is contained to a large extent in a number of popular discussions prepared by the General Electric Company for the promotion of "Better Light—Better Sight". These are reproduced in the following pages, not only for those who had the good fortune to attend the Lighting School, but also for the instruction of Hydro Utility employees generally, all of whom should be missionaries in the cause, and finally for the public in




*Chatham P.U.C. Lighting Booth at Rotary Fair.*

general that they may apply the principles involved wherever artificial lighting is required so that all may be enabled to see under conditions very close to those for which our eyes were intended by nature.

# Dollars and Sense in Lighting

**By W. J. Sweetman, Manager, Lamp Sales Department, Canadian General Electric Co., Limited.**

WHILE Dr. Luckiesh and his associates in the Lighting Research Laboratory at Nela Park have been working steadily on the subject for some twenty years, it is only during the last two years that what we now call the "Science of Seeing" has developed to the point where we now have something to tell the public in terms which it can understand, appreciate and apply. And it has been during these same two years that we have seen that immensely useful tool, the Sight Light Meter, come into the picture. What we are offering to you in these lighting sales courses is built around those two things, the use of the Sight Light Meter to demonstrate and to prove the Science of Seeing to the public. There are, of course, many side issues, many parallel opportunities, but stripped to essentials, the foundation of this whole program is the combination of this new meter and the Science of Seeing — and around these two, General Electric's New Approach to lighting sales has been built.

It does not sound very complicated, does it? Well, we are very glad it is not. Given two hours and a Sight Light Meter you or I may tell a fourteen-year-old boy enough about the Science of Seeing to change his attitude towards artificial light and electric service for the rest of his life. And we may also do the same thing with any reasonably spry grandmother of eighty, or a business executive in the prime of life, or any housewife.

This thing is simple. Our application and use of it may take a variety of forms and the administration may become a complicated job, but the story we have to tell is simple.

In that simplicity lies its strength. Anyone can understand it, anyone can be made to see its importance.

In the past, we have many times made especial efforts to sell the public on special parts of it on the value of good lighting. Sometimes we have been somewhat successful, but by and large the public to-day regards lighting as a necessity, grudgingly used and reluctantly paid for, something wasteful, something to be used only in unavoidable minimum amounts. We might as well face it frankly, our customers grudge us practically every cent they spend for lighting. And in some fields, notably the home, where we know and have known that lighting was simply terrible, we have done next to nothing in our attempts to develop the market. While some may have stirred up a very brief increase in lighting fixture business, I

think it is fair to say that there has never been a really comprehensive home lighting sales activity in this country. True, we have gone farther in the commercial and industrial fields, yet I doubt that any of us have ever been fully satisfied with the job we have done there. I believe this has been due to the fact that every customer has bought some light as a necessity and we had neither the need nor the knowledge to sell light as a benefactor that now exists.

We have therefore lacked a convincing method of showing the value of what we wanted the public to buy—the value to them, I mean. Even those of us in the industry, as a rule, were hardly sold on our own product. Have our homes been especially well lighted? Has the lighting in our places of business been anything to brag about? There are exceptions, but as a rule the answer is "No". There is little wonder then, that what we have failed to accept wholeheartedly ourselves, we have not been very successful in selling to the public.

"Came the Dawn!"—You all remember that title which appeared so frequently in the old silent pictures, which in a period of but a few years have already become quaint. And following this title there usually came a sequence of action that materially changed the whole structure of the plot. If I were a scenario writer and were telling the story of our business, I would use that title at this point.

We have arrived at a new dawn in lighting sales with the development by General Electric of the New Approach to Home Lighting Sales and Commercial and Industrial Lighting Sales. We have arrived at a point where any reasonably good salesman can go out in this city or any other and make a living for himself, a profit for his company, by the use of General Electric's New Approach to lighting sales.

If some of you were thinking aloud right now I believe we would hear you saying that that is a fine theory and you hope it is correct, but how do we know that it works? We do know that it works. The New Approach has been in operation in some localities for two years and in many others for nearly that long. For many months now, the General Electric has had a large staff of experienced men and women in the field all over the country, engaged in a research into the results of the New Approach. We know how it has worked out in large cities and in small towns, we know how it has worked in homes, in stores, in factories, and in offices. We have combined the experience of more than a dozen operations, so that we are able now to give you facts instead of theory, plus the benefits of the experience that has been gained in transforming the new approach from a mere idea into a working and successful actuality.

We have discovered a number of things,—we have found out some methods of operation which are better than others, some places where results and profits have far exceeded those obtained in others. But in all places we have found one thing which is to me, at least, the most promising, the most hopeful and heartening fact that I have ever run across in this business; namely, that the public does accept this new philosophy.

During this program you will hear

of the actual experiences of others; you will learn of results that will probably give you an understanding of why people become increasingly enthusiastic over this as they go deeper into it. And I am confident that a year from now, your own experiences and results will be added to those of others to inspire still greater lighting activity throughout the country.

For many of you this is the beginning. I might say for all of us it is the beginning, for there is so much to be done and we have yet so far to travel along the lighting highway that the steps we have taken during the past have been only those of learning to walk.

As we begin, I think it important that we fix firmly in our minds the fact that we are to be, first, last and always, salesmen. It makes no difference what titles the members held or what training and knowledge they have; what they know becomes valuable only to themselves and others as they learn to make other persons understand and want it.

Much research, much science, much engineering has been employed to develop the lighting message which you will carry to the public. As you go along with this work your own technical knowledge should constantly increase. But all your technical knowledge and all the technical knowledge of your company and mine is only of value to the extent that it is interpreted to the public in a way which will make them want to use lighting more intelligently. Your job, the job of telling people what better lighting can do for them, is the most important of all the jobs to be done—it is the sales job.

So this four-day training course which we now begin is a sales course built on scientific knowledge. Its purpose is to teach you the story of the Science of Seeing and provide you with the tools to prove that story in such a way that *you* can carry it to all who have eyes to see with. No thorough training could be completed in four days, but the fundamentals will be established and the foundations laid. After completing this course, if you will carry the message of better lighting with you in your work, you will find a much greater appreciation on the part of the public for the services which your company offers. And for yourself will come the added satisfaction of work well done, and a service well rendered to the public.

# Eyes Right!

By H. Freeman Barnes, Manager, Lighting Department, General Electric Company, Nela Park, Cleveland, Ohio.

*NOTE:—This is not intended as a presentation of the technical or scientific aspects of this new Science. It does not pretend to treat the subject fully, but deals primarily with LIGHT as one of the major factors in SEEING.*

EVERYONE knows certain things about the relationship between light and the ability to see. We know that even with the best of eyes if we have no light, we cannot see. If we have a little light, we can begin to see a little. And, if we have more than just a little light, we can see a little better.

However, as we increase the amount of light, we finally reach the point where we say, "I can see all right now."

If you were sitting on the couch in the living room near the window, reading by the fading light of day and someone suddenly would say to you, "That light isn't very good—be careful or you may ruin your eyes"—your reply might be, and oftentimes is, "Why, I can see all right!"

And, if you were asked, "Why, yes, perhaps you can see all right—but for how long—and at what cost?"—your response might be, "Well, I will admit I can't see much longer by this fading light, but as to cost, it doesn't cost anything. The cost starts when I turn on artificial light."

Suppose the phrase—"how long"—meant how long in terms of years of your lifetime, rather than the immediate few minutes. Wouldn't you then stop to think whether or not, if you continued to use your eyes under poor seeing conditions, you might begin to lose the use of those eyes at 45, 50 or 60?

And, if the word, "cost," were interpreted not as meaning cost of light, but cost to you in terms of happiness, business success or the ability to see well, wouldn't you again wonder, at least, whether you ought to investigate this matter of seeing, purely on a basis of your own personal welfare?

The fact that "Life Begins at Forty", as someone has discussed, may be true or false depending to a great extent on our ability to see, to read and to enjoy life at forty and beyond. We all know of many, many cases, where impaired vision makes a mockery of that phrase.

With most things which we want, we can buy or obtain them when we want them. At fifty, if we want a new automobile, we can obtain it. If we want to travel, we can buy travel. If we want food, clothes, entertainment, or what not, we can purchase them just when and to the extent we desire.

But, with certain things—and good eyesight among them—if we want those things later in life, we have to purchase them now. Or, at least, we have to think about them now and do something about them now, in order to make sure we will have them in later years.

Easy seeing, in a broad sense, is

something we all instinctively want, now, and in later life. And yet, how little most of us know about seeing, about the care of our eyes—or about the cost to ourselves or to our family; how few of the fundamentals about *that one* of our senses through which we receive the majority of our knowledge, education and happiness.

### Seeing

If we are to understand something about seeing, and, particularly, the relationship of light thereto, we will have to go back a few years—not a mere hundred or a thousand years, but back several hundred thousand years. Back during the time when our eyes and our bodies were developing into the kind of eyes and bodies which we have to-day.

You know most of us think, because we live in a modern home and wear modern clothes, that our eyes are the product of a modern civilization. Nothing could be farther from the truth.

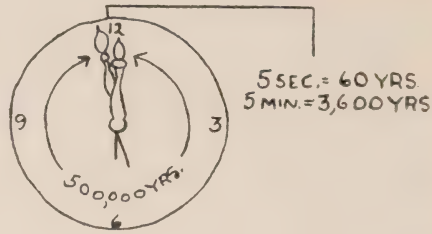
The eyes which you and I have to-day are the result of a development of over a million years or so.

In time, nature changes our physical organs to correspond with conditions under which they are used, but nature moves with maddening slowness. It takes thousands upon thousands of years to make even the slightest fundamental changes.

### Old Man Nature

It is rather difficult to visualize even half a million years.

Let us assume that the twelve hours of a clock from noon to midnight represent these half-million years down through the ages in which man has developed into what he is to-day,




and follow the hands around, hour after hour to a point just before midnight—five seconds 'til midnight—those five seconds representing our own life time. What a small fraction of man's total existence we are living to-day!

During most of this time that man was developing, he was essentially an outdoor creature. His eyes, for example, were built to function under high intensity of illumination—daylight. He used his eyes primarily for long distance seeing and when the sun went down he went to bed.

And this continued for thousands and thousands of years. Within the last minute or so of this journey of ours upon the clock, man started to use his eyes for closer vision—pottery, weaving, and later—within the last thirty seconds—to start to read books and papers.

Most of these tasks were done out of doors. Very little was done under artificial light. Even in Abraham Lincoln's time very few people studied or sewed or read as we do far into the night. But recently in the last two generations we have become civilized—modern. We have developed all kinds of indoor-located machinery which we run night and day and on dark days as well as sunny ones.

So, let's see what we modern, civilized people, who claim to know so much about the right things to do,

have accomplished as far as seeing is concerned: Let's list the factors about seeing under Nature's Out-of-Door Plan and opposite those let's see how we have changed them as we have come indoors. Let's call the first Nature's Plan and the second Man's Plan.

| NATURE'S PLAN | MAN'S PLAN |
| --- | --- |
| High Intensities | Low Intensities |
| Distance Seeing | Close Vision |
| Sunrise to Sunset | All Hours of the Day and Night |
| Easy Visual Tasks | Abnormally Severe Tasks |

Suppose for the moment we wanted to go back to nature's plan. Could we do it? It would be a rather difficult thing as far as tasks are concerned. And civilization requires that the eye do intricate work day after day. We probably would not go back to a normal day. We could not go back to long distance seeing. However, if we examine the matter of intensity, perhaps there is something here we can do.

The eye is truly a remarkable organ, but it hardly is so remarkable as to be able to adapt itself, in the short space of a few seconds on our half-million-year clock, to these different conditions. Perhaps that is why so much eye trouble is prevalent to-day. But let's take a look at nature's lighting intensities as contrasted with man's and see what we have accomplished.

SUNLIGHT TO LAMPLIGHT

Sunlight measures around 10,000 footcandles. Too bright, perhaps, for comfortable reading but not bad at all for playing golf. In fact, we complain when the sun isn't shining, rather than when it is. The intensity in the shade of a tree may be 1,000 footcandles or more. Ideal, we say, for reading. Easy on the eyes. A great place to read for the afternoon!

We sit on the porch—a nice place to use our eyes—under, say, 500 footcandles. We don't complain of too much light.

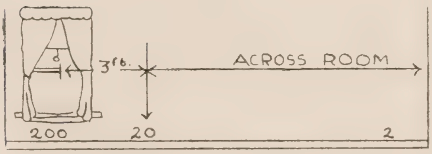
We sit inside during the daytime, pull our chair close to the window, and think we have good light. Yes, it is reasonably good—200 footcandles. Then at night, when many of us use our eyes more than in the daytime for close vision, we blithely turn on a 40-watt bulb in a bridge lamp and proceed to read our newspapers under the "terrific" intensity of 3 to 5 footcandles!

Even in the daytime, if our desk is reasonably near a window, we may be able to get 50 footcandles. But if we are so unlucky as to be on the

opposite side of the room, we may be getting only 3. (We wouldn't play golf under 3 footcandles!)

Perhaps we turn on the lights, and the fixtures of the average so-called "well lighted" office give us an additional 5 or 8 footcandles. Stupendous quantities of light—1/1000 of sunlight—a hundred times less than in the shade of a tree!

### Let's Measure It




There has recently been developed a little light meter which measures light as readily as a thermometer measures heat. Let's place it by the window. Yes, 200 footcandles. Let's move away three feet from the window. Why, it doesn't seem possible—only 20 footcandles. Let's move across the room away from the window. Incredible! Only 2 footcandles. What has happened? A hundred times more light by the window than across the room. Thus, we see how rapidly light intensity diminishes as we move away from its source. Even with a 100-watt bulb in a table lamp, at an average reading distance, we would get only about 20 footcandles—and at twice that distance, less than 5.

Well, what of it? we say. The eye is a wonderful instrument. Yes, wonderful, because with all this mistreatment it is slow in complaining. Yet statistics show us that among school children, 20 per cent. have defective vision, notwithstanding the fact that nearly all of us are born with normal eyesight.

At Birth—Perfect Vision
School —20% Defective Vision
College —40% " "
60 Years—95% " "

Most of us are born with good eyes, just as good as our lungs, heart, or limbs. And yet, as children leave college, 40 per cent. have defective vision. And by the time they reach 60 years of age, over 95 per cent. have defective vision.

### Teeth—Wheel Chairs

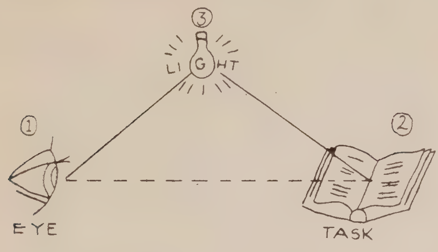
There has been a lot done on dental hygiene. It is taught in schools. It is written about copiously in books. Yet, compared to eyes in importance, of what value are teeth? Why bother with teeth at all. If teeth get bad, we can have them pulled out and false teeth put in place, and even with this makeshift we can get along fairly well.

But when it comes to eyes, while we can replace eyes with mechanical ones which may look almost the same, nothing can be done to restore lost vision. It is gone forever, beyond hope of recovery.

If teeth are so important, and they are, how much more so are eyes. Suppose we translate eye defects, for example, into leg defects. What a piteous sight our streets would be. Every other person would either be on crutches, using a cane, being wheeled in a chair, or clattering along on a wooden leg. Appalling? Certainly.

### The Seeing Triangle

There are three factors which make seeing an actuality. Let's call them




the Seeing Triangle. First, of course, is the eye, without which we cannot see at all. Second, is the task, the thing the eye sees. And the third, the light—either natural or artificial—which makes it possible for the eye to see the task.

*The Eye*

At any given time in life, we must accept the eye largely as it is. If it is a sixty-year-old eye, there is nothing we can do to make it a twenty-year-old eye. If it is a defective eye, the chances are it must remain defective. What we can and should do about the eye, however, is to consistently keep it as sharp as possible. This means regular visits to an eyesight specialist, and the use of glasses, exercises or treatment to keep our eyes, no matter what their condition or age, at their highest efficiency.

To make seeing easy, the eye must be in the best possible condition. Of course, we know that the eye requires care. Sticks or stones, cinders or foreign bodies do not help the delicate structure of the eye. We instinctively know that, but too few of us realize the harm that may be done by attempting to medicate or treat our own eyes. This is an eye specialist's job and not ours.

*The Task*

The task—a book, a newspaper, pounding a typewriter, running a lathe, etc., is again a factor about which there is very little we can do. Where we have a choice, we should select those eye tasks which are easy rather than difficult, and even though most tasks are fixed, as far as we are concerned, we should do all we can to make eye tasks as easy as possible.

*The Light*

The first two factors, therefore, are largely beyond our individual day by day control. The third factor, light, is wholly controllable—all the way from zero up to a terrific intensity. We know that while we can see in moonlight, such a low intensity, is not sufficient for easy reading. Where, then, should the intensity be. Does it make any difference whether it is ten footcandles, or fifty footcandles? Does it make any difference whether the eye is old or young, normal or defective? Does the difficulty of the task make much difference?

Obviously, the intensity of light must be a factor. Where, then, should that intensity be? And the answer to this question has come out of years of patient research so that to-day we *know* where that intensity should be, where yesterday we only guessed, or thought we knew. Now, we know how much light the average eye needs for reading a book—and we know that reading a newspaper takes on the average three times as much light—if we are to ask the eye to read the newspaper with the same ease with which we read a well-printed book.

We know that a sixty-year-old eye, because the pupils grow smaller with age, takes considerable more light than a twenty-year-old eye.

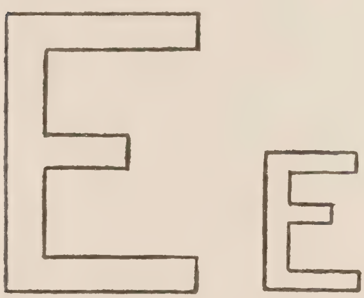
And so, to-day, we can specify the proper intensities of light based not upon the phrase, "I can see all right", but rather, taking into account the major factors of eye strain and consumption of nervous energy.

And thus, intensities start out at ten footcandles and go on up to fifty, one hundred and more.

### SIZE, CONTRAST AND TIME

*Size*

Why is it that a newspaper is harder to read than a well-printed book? For one reason, the type size in a newspaper is generally smaller than in a book. And we learn from experiment that the larger the subject, the less light we need to see that subject easily.



1 F.C. 100 F.C.

Here is the letter E. Let us say we can just see it under an intensity of one footcandle. As we increase the intensity, how much smaller can we make the E and still see it? Here is a surprising thing. If we decrease the size of the E one-half, we have to increase the intensity of light 100 times. It is not only important to know how much light it takes, but the real important and valuable thing is, that higher intensities increase our ability to see smaller objects. Light, therefore, acts as a magnifier.

*Contrast*

We know that the contrast between the type and paper in a newspaper is not as high as in a well-printed book. Contrast, too, is an important factor. The greater the contrast, the less light we need to see easily.

A white thread on a black cloth is much easier seen than a black thread on black cloth. The latter requires infinitely more light.

*Time*

We think we see instantly. Such is not the case. It takes time to see. Time for the eyes to focus. While we can see under moonlight, it takes longer for us to make sure of what we see than in broad daylight. That is why, up to a certain point, increasing the intensity of light speeds up production.

In other words, the simpler the task, from the standpoint of large size and good contrast and the more time we have to do that task, the less the light required.

Conversely, a task which is an intricate one for the eye, (such as reading a newspaper) requires an amount of light considerably above the five footcandles we usually provide.

### IN THE SHADE OF A TREE

The ideal setting for reading a newspaper would be out-of-doors in the shade of a tree—plenty of light and no harsh contrasts. But even this is not strictly true since any *close* vision is not ideal. To make the reading of a newspaper ideal, we should place that newspaper at least fifteen feet away from us; make it twenty feet tall with type to match. Then we would have removed the "bow-legged" conditions of close vi-

sion—the conditions under which the eyes converge on an object.

### Your Preference

People often ask "How much light should we have in the dining room?" The man probably says, "I like lots of light but my wife insists on having candles." Which is right?

Who shall say which is right? It is entirely a matter of personal preference. If you like lots of light, then that is the thing to have. If you prefer candles, then perhaps candlelight is sufficient. People do not use their eyes to any great extent at the dinner table. All we need is enough light to be able to distinguish forks from spoons, potatoes from carrots.

How much light should one have in the hall? This again is a matter of choice. How much light do you want? How much light should there be on the porch? How much light in the bedroom for general illumination? Should there be a big lamp on the cellar stairs?

And in none of these places can any definite rules be laid down. You want just enough light on the cellar stairs for safety's sake. You want to be able to see where you are walking and not stumble over the kiddy car or take an unlooked for ride on a pair of roller skates.

### Science Rules

But—and this is important—when you start to use your eyes for reading, sewing, studying, playing games, writing, etc., then the Science of Seeing steps in and says in effect, "Here are the minimum amounts of light you *must* have for proper seeing conditions; when you start to use eyes it is not a matter of choice, guesswork, or preference." Science tells us now very definitely the proper amounts of light we require for various eye uses.

Remember our eyes were built for out-of-doors. Upwards of a thousand footcandles under a tree, five hundred on the porch, and indoors two hundred footcandles near a window. Certainly something is radically wrong when we try to read or sew under five footcandles.

### Energy

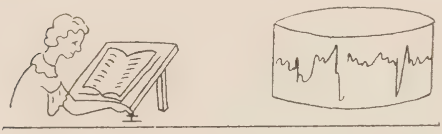
It is not only a matter of eyestrain. It is a matter of needlessly using up untold quantities of nervous energy. The statement has been made that the office worker who uses his eyes all day under inadequate light may be actually more tired at night than the man who spends a day digging ditches. The Science of Seeing indicates quite clearly that it does take energy to see and that seeing consumes energy just as definitely as digging ditches or washing dishes.

Suppose you drive an automobile for fifty miles on a bright sunny day over a straight piece of road. At the end of the ride you notice no particular exhaustion. Then take the same automobile, the same road and make the same drive at night—in a fog. After fifty miles of this you know you have been doing some work. But the only difference has been the lighting. You have gripped that wheel, tensed your muscles, strained your whole body, not doing any particular work but using up a terrific amount of nervous energy in trying to see.

In testing this in the Laboratory, dozens of subjects—human beings

like you and me—were picked, asked to seat themselves in a comfortable chair, and to read page after page of a well-printed book.

Each subject was asked to place his left hand on a button on the table, and to push that button at the end of each page. (Not that he should try to read fast, but just as a timing device to see what happened as the lighting intensity was varied between one footcandle, ten, one hundred, and so on.)



What the subject did not know, however, was that we were not interested at all in having this button pushed at the end of each page. That button was a subterfuge which recorded continuously on a revolving drum the amount of pressure exerted by the hand all of the time the reading was being done, and it was discovered after thousands of tests that there was a direct relationship between low intensities and heavy pressure on the key. The higher the intensity the greater the relaxation and the less the pressure.

TIRED BUSINESS MAN

This explains why the business man seated in a comfortable chair, summoning his secretary with no more work than pushing the button may be truthful when at night he says, "I'm all tired out. I have had a hard day".

And perhaps this man's wife looks at him and says, or thinks, "What right have you to be tired? I'm the one that should be tired. Why, you haven't done a bit of real work all day."

We see the same man finishing his dinner, settling down for a quiet evening to read his newspaper, gradually nodding off and finally going to sleep. His work in the office under inadequate light has sapped a lot of his energy. The mere process of digesting a heavy meal takes a lot more, and when on top of that he attempts to read a newspaper under insufficient light, there isn't enough energy left to keep him awake.

So, in addition to the list of penalties we have imposed on the eye, chalk up another one for wrong lighting—unnecessary expenditure of energy.

People who use their eyes; typists, bookkeepers, printers, mechanics, etc., too often become unnecessarily fatigued before the day is over. Proper lighting will do much to correct this.

So we have found out through the work done in establishing the Science of Seeing, a lot of things we never knew before. And here are some of them—

*That* if your child has to hold the book he is reading much closer than 14 inches, the chances are his eyes are being strained. The remedy is eyeglasses or better lighting, or both.

*That* a man who uses his eyes under poor lighting conditions for prolonged periods frequently suffers more nervous-muscular tension than a manual worker.

*That* poor lighting is one of the causes of near-sightedness.

*That* it is estimated, we are using our eyes for severe visual tasks about 30 per cent. more than was common a

generation ago—and many times more than a century ago.

*That* it takes 3 times as much light to read a newspaper with the same ease as it does a well-printed book.

*That* good lighting aids defective eyes even more than it does normal eyes.

*That* reading with the page brightly illuminated and the rest of the room comparatively dark often causes unnecessary eyestrain and fatigue. Some light should be permitted to go to the ceiling so as to reduce the harsh contrast, which is bad for the eyes.

*That* light acts as a "magnifier" of small details. An object must be twice as large to be visible under 1 footcandle as it would have to be under 100 footcandles.

*That* while civilization has lifted burdens from the back of human beings, it has greatly increased the severity of visual tasks.

"But how can you prove this to me," you ask. "It all sounds logical. I agree that it *ought* to be true and yet—somehow I am able to read pretty well under these low intensities of 5 or 10 footcandles."

A rather simple experiment can prove to anybody that eyes—of themselves—will select intensities far higher than provided, when our mind, rather than our pocketbook, does the selecting. A lamp bulb designed to give high intensities of light—as high as 500 footcandles, is screwed into the socket of an ordinary bridge lamp. A rheostat or a control device, (a simple little knob) is provided to increase or decrease the amount of light.

You, wishing to test your own eyes, seat yourself in a chair alongside of which is this lamp. You pick, let us say, a newspaper, and you turn the knob, raising or lowering the light until your eyes *alone* tell you that a certain amount of light seems most comfortable. Then you take a light meter and measure that amount of light—right on the newspaper—and we will promise you a surprise. Those eyes of yours, which have been reading that newspaper, due to your previous selection of lamp size, under low intensities, *have automatically selected a quantity of light 10 to 50 times as much.*

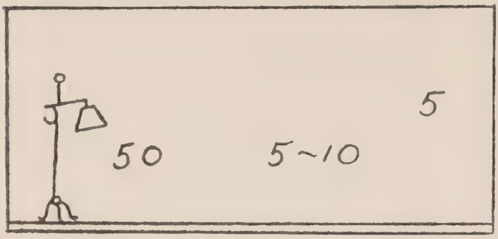
Eyes vary. Some people will select 75 footcandles. Other people with apparently normal eyes, may select 200. Often-times people with defective eyes may select as high as 500 or greater.

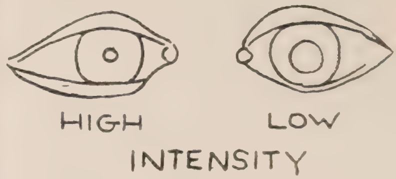
### So What?

Well, what can be done about it? What can you do about it in your home, or I in mine? We can do something very definite. We can do it easily and in effect accomplish wonders. We now know certain things. We know we want plenty of light. We know we want light without glare because glare is a terrific strain on the eyes. And so we list the requirements for lighting a living room—

1. Enough light—25 to 100 footcandles.
2. Not too severe a contrast.
3. Absence of glare.
4. Enough light in enough places.

We know something now about No. 1. But we may not appreciate the importance of contrast. Let us say we are lighting up a book to an intensity of 50 footcandles. We have been accustomed to perhaps 5 or 10. The




immediate reaction in many cases is, "Oh, that's too bright! That's too much light." And yet we know it isn't too much light. We have 200 footcandles by a window. What then is the matter? We have not provided too much light, but we have provided too *little* light throughout the rest of the room. If we are to have 50 footcandles on our book, there should be from 5 to 10 throughout the rest of the room. This seems foolish—why light the middle of the room if one is to read over in a corner?

Let's see what happens when we read under 50 footcandles and put no light throughout the rest of the room. The harsh contrast between our brightly lighted page and the surrounding area causes the eyes to readjust themselves—shift gears, so to speak—every time they glance out into darkened parts of the room, which they do frequently, without our being aware of it. This tends to tire them.

Now let's put 5 to 10 footcandles throughout the room. The contrast between our book and the rest of the room is not nearly so great, and strange to say we find our reading much more comfortable. Keep the ratio of 5 to 1 in mind when laying out the lighting for your living room and your eyes won't suffer from contrast.

That is why we recommend having lamp shades open at the top. This lets part of the light go to the ceiling—to other parts of the room. That is why we recommend an indirect floor lamp in addition to the bridge or table lamp we may be using for reading.

*Glare*

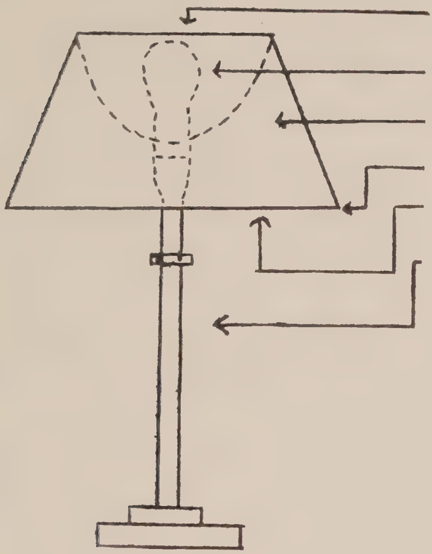
Now, we come to No. 3, the question of glare. We all know that a glaring light source is uncomfortable, and yet, stop and think how little most of us do about it. Wall fixtures and ceiling fixtures unshaded, are marvelous producers of glare. The average bridge lamp, while not a source of glare to the person who is using it, may be quite glaring to the eyes of someone across the room—if the bridge lamp is improperly adjusted.

Sitting facing a window is hard on the eyes due to brightness and glare. Reflected glare from polished surfaces or shiny paper is hard on the eye. And the average table or floor lamp, unless very carefully placed, produces glare from exposed lamp bulbs which the shade does not hide. Glare may do as much damage to the eyes as insufficient light.

*Lamp Shades*

And, while we are talking about glare, let's examine the simple requirements for a lamp shade, or a

table or floor lamp. The shade must be:




And now for requirement No. 4,—light in enough places. One bridge lamp can never be adequate for a couch or divan. It takes two lamps, one at each end, or a floor lamp behind the couch. Light must be provided so that at any place where one may sit and use the eyes, sufficient light is easily obtainable. Thus we need a light for the piano, a light for the desk, a light for each easy chair.

And now back to No. 1 requirement. How do we get enough light? Well, we talk in terms of wattages. No lamp for reading purposes should ever have less than 100 watts. A bridge lamp, conceivably, with a very good shade, might get along with 75 watts. But the average bridge or one-socket table lamp needs 100 watts in order to provide 15 to 20 foot-candles at the average reading distance. If the lamp has two sockets it needs a minimum of two 60's; if it has three sockets a minimum of two 40's and one 60, or perhaps three 60's.

And don't forget that with all this it may be necessary, and generally is, to supplement this lighting, even with shades open at the top, with an indirect unit of from 150 to 300 watts for general room illumination.

"Wait just a minute," you say, "I have tried these higher wattages in my bridge lamps and portables, but they're just too bright. They don't seem comfortable." And that's the sad part of it. A great number of the lamps in our home to-day—designed primarily for looks and style—just simply won't do. A 100-watt bulb in the average bridge lamp is rather bright. Three 60-watt bulbs in many table and floor lamps do a nice job of producing glare.

*New Lamps*

It's just too bad, but what you and I have to do is to get new lamps designed both for beauty and seeing. Fortunately, there are now on the market quite a few portable lamps which do a good lighting job. Notably among these are the various I.E.S. Better Light—Better Sight lamps. These lamps embody all the requirements for providing good light for eye use in the home, and, in many cases, in the office.

SOFT LIGHTS!

"I can't stand bright lights," says the housewife. "I want soft lights." Soft lights are perfectly all right for conversation, or listening to the radio, but they are *not* all right for reading or sewing.

Soft lights may be ideal for beauty and complexion purposes, but when it is a question of saving eyes and saving energy, beauty must take second place Not that good lighting and beauty cannot go hand in hand. They can and should. A well lighted room can be beautiful and not harsh on the complexion. And it helps to prevent these unsightly eye-wrinkles that come from squinting!

Good lighting helps those most who need it most. And, while all of us need good lighting, perhaps it is our children and our old folks who need it most—the child, because his life is before him and we will not knowingly handicap him by providing inadequate light; Grandpa and Grandma, because most of their lives are behind them and in their waning years we want to give them all the enjoyment and comfort in our power.

Let's ask ourselves these questions. In our home, or store, our office or factory, or on the streets of the town in which we live, are we attempting to adjust the eyes to artificial light? Or, are we adjusting artificial light to eyes?

Let's remember the two important things about seeing. First, place our eyes in the hands of a competent eyesight specialist. Second, provide enough of the right kind of light.

# The Science of Seeing in the Home

(*From General Electric Company Home Lighting Course*)

WHILE evidence abounds to prove that artificial light in the home has not kept pace with other comfort-, convenience- and health-conserving services, there are many indications that daylighting indoors has always been and still is cherished and often thoughtfully considered. In fact only casual observation will reveal our daylight-mindedness indoors. In the earliest days, window openings were limited in size due undoubtedly to the cost of glazing. Later window openings had taxes imposed upon them. As soon, however, as these restrictions were lessened, we may begin to trace a gradual increase in the number and size of windows, until to-day many of the modern designs utilize continuous bands of glass, and even in a few very special cases, we find the entire exterior of glass. In a sense this may be somewhat inconsistent, for in making such extensive provision for the admission of daylight, it very often serves only one member of the family for many homes are only occupied by most of its members after five o'clock in the evening. The children are away at school, or are outdoors playing, while the supporting members of the family are away at work during the principal daylight hour. This thought is not advanced

to take away or reduce daylight from the homemaker, but to introduce a more liberal attitude toward making comparable provisions for artificial light at night, and particularly since artificial light serves the entire family for the greatest number of hours and usually when the eyes of the family are applied to reading, writing and sewing, when it makes no difference whether the windows are large or small.

Further evidence of our daylight consciousness may be found by observing the househunter, whether renter or prospective owner, for he notes the darkened room. The homemaker selects wall paper, curtains, upholstery, and other furnishings in daylight, and the professional decorator and the dictator of fashion so often considers the entire room and its contents with only the effect that is achieved in the daytime. Finally, we may note the frequency with which we find the most comfortable living room chairs, and even davenports, at or near windows. The sewing bag or basket is often found near these places, and these latter situations are well to bear in mind when approaching the homemaker about the lighting in her home. All of these conditions speak her natural desire to have enough light during the daytime. Measurements of the intensity of light at or near unobstructed windows on clear days show us that these places approach, in light value, Nature's values out of doors. One hundred footcandles may be measured on the window sill (exclusive of direct sunlight)—still these values are but a fraction of what may be found in the shade of a tree on a clear summer day. And as we move a foot or so away from windows, the values often drop to 30 or 20 footcandles, while in the centre of the room it is very likely to be 10 footcandles or less. Unless shades are raised to the top and curtains or hangings are removed, the real seeing values of daylight are usually quite limited to areas near the windows, and since we know people will select *more* than 10 or 20 footcandles of light for reading when they can get it readily, it is quite natural that we find evidence of this in furniture placing.

Inasmuch as few homemakers know that light can be measured, and accordingly have never known the actual values of daylight which fall on the book or paper when one is seated in chairs at windows, the measurement of this value serves to illustrate a number of lighting points.

When, for example, the chair selected for the purpose has a portable lamp beside it, the value of daylight at this chair can be measured and then the artificial light can be turned on and measured for comparison.* In this way the marked difference is shown between the two. The daylight values may be expected to register between 20 and 50 footcandles; values which are the minimum recommended for reading fine

* This comparison would be made by drawing the shades during the brief period during which the artificial light measurement is made. With drawn shades the daylight value will usually be reduced to one or two footcandles excepting at such times as direct sunlight is falling on light-coloured drawn shades. To determine the artificial light value which would be shown at night, the low daylight value obtained with drawn shades is noted and subtracted from the reading obtained when the artificial light is turned on, since the reading thus taken is the sum of both the reduced daylight intensity and the full artificial light value.

print, for sewing, and for long periods of close eye work, whereas the artificial light value found in most cases will scarcely ever be above 10 footcandles, the lower limit recommended for ordinary reading. The meagerness of artificial light may be further emphasized when we recall that immediately outside of the window even on a rainy day the daylight intensity would be easily 200 footcandles or more. Nature provided us with generous amounts of light out of doors. These we have in a large measure left behind us even in the daytime, and when we consider the present value of our lights at night, we can appreciate how far from Nature's plan we have strayed. This change alone does not, however, portray the whole story, for our outdoor occupations scarcely ever in the past or in the present call for focusing our eyes and attention on objects held within arm's length, whereas the school child, the college student, the office worker, the business man spend many hours each evening with the eyes focused on papers and books, all held twelve to sixteen inches away. Outdoors we use distant vision to a considerable extent, and distant vision allows the eyes to assume positions that we often use to relax the eyes at night; namely, looking off into space, whereas our indoor usage of eyes calls for a constant turning in of the eyes; a further deviation from Nature's plan. Add to this the very low light values so often found, and further cause for eye-strain is revealed. The dimly lighted page encourages the page to be held even closer to the eyes, for this is the only means left to improve visibility. The page held close makes the type look larger, although this practice places an extremely unnatural task upon many of the muscles of the eyes. Unfortunately young eyes have sufficient flexibility of muscle and lens not only to do this but to do so for long periods of time. Such usage undoubtedly induces nearsightedness (myopia), and checks made on the eyes of children and college students tell us the story of nearsightedness. The number of children who become nearsighted shows a definite increase as they pass from pre-school age through college. In addition, where records of the degree of increase or decrease in nearsightedness were kept, it has been found that it increased from year to year. Plainly, man has not as yet successfully altered Nature's plan. The prevalence of defective vision alone points a challenging finger to man's plan.

Every member of the family must acquire good seeing habits, and this will be best accomplished by teaching these habits to the youngster. Children are taught day after day to wash their hands before coming to the dining room table. They are taught to be considerate of the wishes of their playmates, and we are quite aware of the training they get to insure that their teeth have been brushed at least twice a day. On the other hand, few children have ever had the benefit of having been coached on the best usage of their eyes and light. And curiously enough they are not like the moth which is always attracted to the light. One needs only to watch the pre-school age child sprawled on the floor with crayons, pictures and books on a late winter

afternoon to appreciate the need for training. The daylight has fallen to a low point; the electric lights have been turned on in other parts of the room, but the youngster makes no move to aid his eyes. He merely moves his eyes closer to the task until he has his nose practically on the floor. An adult need only do this with a book held within three or four inches of the eyes for one or two minutes to gain some idea of the severity of this kind of eye usage. We would not think of doing it ourselves, but many a child has gone daily in this manner with no helpful correction from parents.

Again we may find the youngster lying on his back on the davenport with a pillow pushing his head forward at an angle that only youth or a contortionist can enjoy, with the knees drawn up to hold the paper in position. The eye specialist warns against using the eyes excessively elevated or unduly depressed. The eyes of the child in reading the funny page in this position go through the entire gamut of improper usage; and add to this the condition of a portable lamp casting most of the light on the back of the page and the rest more or less directly in the eyes of the boy, and we appreciate still further the need for helpful training.

Children of different ages need chairs of varying heights or desks or table and chairs which permit them to assume good posture and to permit them to naturally place their eyes at approximately fourteen inches from the reading or writing surface. Unfortunately too many children spend their evenings bent over a table built for an adult with their eyes no more than six inches from the page. All of these corrections go hand in hand with properly placed lighting and one calls attention to the other. Surely the advantages to be gained from the conservation of vision and conserved nervous energy are equal to the benefits to be derived from teaching the youth of the country the means of preserving its teeth.

Turning our attention again to the chair, the portable lamp and the window with its daylight supplying from 20 to 50 footcandles, we may take another lesson from Nature. The 100 footcandles at the window do not create the sensation of too much light, and accordingly the 20 to 50 footcandles delivered to the page when seated in a chair do not do so. Furthermore, as we look out of the window on the shady side of the house we do not experience the "too much light" sensation, yet we are viewing objects which are illuminated with many hundreds of footcandles and often a thousand or more. Our Science of Seeing knowledge points out that our surroundings (as well as the localized area to which our eyes are directed) should be lighted. Our view out of the window illustrates surroundings lighted as well as any particular area to which our attention may be directed, and accordingly illustrates the desirability of reducing contrasts between the objects to which we closely direct our attention and the rest of the room. This same intensity brought indoors at night and applied only to our newspaper would immediately set up a disagreeable reaction and the majority of people would unite in agreeing that it surely was a case of too much light.

In this case the restricted area (the newspaper, book and writing pad) which is illuminated may be from 500 to 1,000 times as bright as any other surface in the room whereas it is highly desirable to keep the surroundings illuminated so that they are approximately one-tenth the value of the restricted area. For example one thousand footcandles on the book would call for one-tenth or one hundred footcandles on the surroundings to reduce contrast to a reasonable value.

Actually we need go nowhere near the values of outdoor daylight to create this sensation. A single lamp lighted in an otherwise unlighted room may produce this same reaction when the intensity on the page is only at 20 footcandles. In this case the light coming to the eye from the page will easily be more than ten times as great as the light coming from the walls that we may look at as we raise our eyes. We have gone, therefore, considerably beyond our desirable ratios of general lighting to local lighting. If, however, we add the light from some other lamps, a good overhead fixture, or from an indirect lamp, we are started toward reducing the high contrast between the page and the wall, and our difficulties diminish. A single lamp may be used in a moderately sized room if it also supplies a reasonable amount of general light at the same time. This is illustrated with the lighting which we obtain from the Illuminating Engineering Society specification lamps such as the Study and Reading Lamp and the Semi-Indirect Floor Lamp. On the other hand the conventional metal shaded student lamp and the closed top bridge lamp when used alone, very easily offend since they do not provide their own softening general light, and yet they may be easily placed to produce rather high intensities of localized light.

In average living rooms we automatically provide much of this contrast-relieving light by having a number of the regularly placed lamps turned on. However, these in the main should have open top shades so that light will go to the ceiling. At this point we may find some difficulty in achieving the result when ceilings and walls are quite dark. Dark finishes absorb light and accordingly a greater amount of light will of necessity have to be delivered to these surfaces to offset their darkness. When dark wallpaper and paint are found, the desirability of using lighter finishes when these surfaces are renewed should be pointed out to the homemaker. These same dark finished rooms do not present any particular difficulty in the daytime, for the great volume of light which may enter through the windows effectively offsets to a considerable degree the effect of the dark finishes.

From the foregoing we may learn how the several important lessons from Nature may be applied to our indoor lighting and we also learn that we are now in an era when we can no longer delay in bringing man's plan closer to Nature's plan. Nature's plan provides an abundance of light freed from excessive contrasts,—it requires us to use our eyes principally for distant vision and no great concentration of attention, except for moderate amounts of time. Man's present plan can be altered, not so

much perhaps by a lesser use of the eyes, but we can provide materially greater intensities of light and at the same time we very materially reduce the contrast and glare which are so prevalent in much of the lighting in our homes.

Quantity of light, quality of light and quality of lighting are our principal tools in the crusade, and the steps to be made are truly very great. "Quality of *lighting* at this point should be differentiated from quality of *light* itself. The quality of lighting pertains primarily to its direction and softness. Softness may be judged by the harshness and shadow created. Hard, disagreeable lighting creates black and clearly defined shadows, while a highly diffused lighting and soft lighting creates soft shadows which do not have clearly defined edges. At the same time lighting which lacks in softness also produces images of the light itself right at the point where we wish to read when we use books, magazines and paper, unless they are very dull surfaced or particular care is exercised in holding the page in such positions so as to prevent these annoying reflections from entering the eye. Perfectly flat pages can be successfully handled, but many of our thicker magazines cannot be so held flat and we are constantly annoyed by the images of the light itself reflected from the page at the point where we wish to read. A small hand mirror held on the page at the point where the eyes are directed will usually reveal the cause of this annoyance. If the mirror in this position reveals the presence of light sources the difficulty will be eliminated by moving the portable lamp, usually to the right or left. When the best arrangement is made images of the light sources will not exist in the mirror. Obviously it may be necessary at times to move the chair in which one is seated to obtain this improvement.

Quality of light pertains to the colour composition of light itself. For example, the difference in whiteness which we may note between daylight and ordinary artificial light is due to the fact that the composition or mixture of colours of light which combine to produce daylight has a greater amount of blue in it than the mixture which produces our regular artificial light. In our homes artificial daylight at night appears very cold, even bluish, and for the most part we do not find people favouring this bluish effect in the living room. This, no doubt, is due to man's long association with the yellowish light of flames; an association which carries with it the cheer and comfort of the home at night. This association has left its imprint upon us and we find slightly yellowish light more pleasing. It appears logical that the quality of daylight is ideal since it is again a part of Nature's plan. However, it seems likely that *quantity* of artificial light indoors is far more deficient than its *quality*. To a certain number of individuals it appears that light of daylight quality is superior to that of regular artificial light. For those who are certain of such effects approximate daylight may be provided with daylight lamps. The greenish blue bulb absorbs one-third of the light so that larger lamp bulbs are required to produce a given amount of light. In a good bridge lamp, for

example, which is providing 20 footcandles with a 60-watt inside frost lamp, it will be necessary to use a 100-watt daylight lamp to produce approximately this same value of lighting. In the great number of cases, however, it is found that artificial light is inadequate and glaring and these two deficiencies constitute a far greater departure from Nature's plan than does the colour of the light.

The seeing effectiveness produced by changes in the quantity of light as derived from the findings of the Science of Seeing reveals a different picture than we may have suspected. Two and two no longer make four. Two footcandles added to two footcandles do produce four footcandles, and when this is done we have doubled the intensity and accordingly have added enough light to have really made a significant and demonstrable change, but the next two added footcandles which increases the value to six is not double the value of four, and we have only made a one-half step in our scale of seeing effectiveness. Two footcandles added to twenty is of very little significance for we must double 20 or go to 40 to reach the next significant step. Even 50 footcandles is lost if we start, for example, at 500 footcandles (a value easily attained on the porch in the summer) for in going to our next significant change from 500, we go to 1,000. Fifty in this case is but a small fraction of 1,000, and is practically lost in seeing effectiveness under these circumstances. From these examples we see that a single footcandle is only important when we have only a few; as we increase to higher and higher values, a single footcandle soon loses significance. To-day we may specify lighting intensities in accordance with their seeing effectiveness. The scale of footcandles such as 2, 5, 10, 20, 50, 100, represents approximately equal steps in improvements in seeing. In bearing this scale of effectiveness in mind we readily comprehend the desirability of increasing the wattage in a bridge lamp having a 40-watt lamp to a 60- or 75-watt lamp. This change assures us of roughly doubling the amount of light and makes the equivalent of one step in seeing scale of effectiveness. Furthermore this change is sufficiently great so as to assure a successful demonstration of its actual effect.

The severity of the task, the duration of eye application, and a number of other governing factors are all combined with this footcandle scale of effectiveness in producing the table of recommended intensities for the various seeing activities in the home which follow:

RECOMMENDED LIGHTING INTENSITIES FOR THE HOME

(*Approved by the Illuminating Engineering Society*)

| | Footcandles |
|---|---|
| Reading | |
| Prolonged periods with fine type | 20-50 |
| Ordinary reading | 10-20 |
| Sewing | |
| Fine needle work on dark goods | 100 or more |
| Prolonged average sewing | 50-100 |
| Prolonged sewing on light goods | 20-50 |
| Ordinary sewing on light goods | 10-20 |

| | Footcandles |
|---|---|
| Writing (ordinary) | 10-20 |
| Card Playing | 5-10 |
| Children's study table | 20-50 |
| Dining room (when used for ordinary reading or writing rather than for ordinary dining.) | 10-20 |
| Kitchen | |
| General | 5-10 |
| Local at work counters and sink | 10-20 |
| Bedroom, general | 2-5 |
| Bed light | 10-20 |
| Dresser, vanity and dressing-table mirrors* | 10-30 |
| Sewing machine | 20-50 |
| Bathroom mirror* | 10-30 |
| Children's playroom | |
| General | 5-10 |
| Local | 10-20 |
| Stairways and stair landings | 2-5 |
| Work-bench | 10-30 |
| Ironing machine, ironing board and laundry trays | 10-20 |

* Intensity value delivered on each side of face.

It will be noted that a range of values is given in each case. A table which sets forth a single value in each case would imply that only one particular single value was a satisfactory one. The researches on light and vision show us that the eyes do not perform in such an exact manner, nor does the nervous muscular tension change markedly for one footcandle at a time. True, if the observations are made at very low intensities, small changes in light value do make significant changes in seeing, but we are not concerning ourselves with the very least amount of light which enables us to see at all, we are now bending our efforts toward providing easy and comfortable seeing for every member of the family.

In providing easy and comfortable seeing conditions for every member of the family, we are not only contributing toward the conservation of vision directly, but we may also conserve much of the needlessly wasted nervous energy which is consumed in seeing under inadequate and improper lighting. People of all ages are benefited, but the advantages to the young and the aged have a particular appeal. In this connection we even find that the kind and amount of lighting supplied to the school child may have a very direct bearing on his success or failure in school. This was illustrated in the recent tests conducted for three successive years in two sixth grade rooms in Tuscumbia, Alabama. Each year records showed that there were fewer failures and more alert pupils in the room provided with the better lighting. The statistics for the three years recorded an average of 3 failures out of 34 pupils in the well lighted class room while 9 failures out of 38 pupils were recorded in the less well lighted room. Let us further consider the school child. Take, for example, the upper elementary grade student who to-day may devote from one to three hours several evenings each week to books and papers. A full day has been spent in school, and after that comes a real play spell on ice skates, roller skates, a ball game, and so on. A rather tired child is also a hungry child, and a hearty dinner is consumed. Heavy eating usually aids in creating drowsiness, and the natural fatigue of the day combines with this toward making it difficult to get at the homework and

to remain at it. Now is the time when good lighting can really make its contribution. Every factor such as a table or desk surface which is large enough for the placing of all books and papers, chair height such that posture is good and eye distance to the work is more than 12 inches to minimize the effect of close eye application, light placed to the left to eliminate hindering hand shadows, and also to eliminate light from shiny surfaced paper from being reflected directly in the eyes no less than 20 footcandles over the entire area being worked upon and not just under the lamp or within a foot of the lamp, a moderate general lighting to minimize the difference between the light on the desk top and the immediate surroundings, all go toward conserving the eyes and the nervous energy expended for the evening for a boy or girl who was already tired before he or she started. Only a brief glimpse of this set of conditions versus the more customary ones leaves little doubt in anyone's mind.

Father's and Mother's as well as Grandmother's and Grandfather's comfort also appeals to us for Father and Mother have already done a day's work, and they are entitled to an evening of relaxation. Father's and Mother's ages are such that in most cases they have begun to lose some of the powers of the eye, and Grandmother and Grandfather have undoubtedly lost more of these powers and they are quite aware of it. The highest values of light comfortably attainable go to them. At their age they experience a natural decrease in the size of pupil. As the pupil grows smaller, less light enters the eyes and visibility is reduced. This can readily be counteracted by increasing the intensity of illumination. Considering only pupil size, average eyes sixty years of age should have about twice as much light as average eyes thirty years of age, while eighty-year-old eyes should have four times as much light. Our new types of semi-indirect portables with the lower auxiliary lamps should prove to be a boon to weakened eyes of older people. However, this does not imply that their use is restricted to elderly people.

In reviewing the benefits to youth and older people, we have applied most of our thinking to eyes that were normal for their ages. We cannot overlook those eyes which are defective, for we may recall from the fundamentals of the Science of Seeing that defective eyes are helped even more by proper lighting than normal eyes. Not that defective eyes are made better than normal eyes with the same improvements in lighting, but rather they receive a greater proportion of benefit. In those extreme cases of eye defectiveness where children cannot be satisfactorily placed with other children of the same age, we find that special eye conservation classes can often prevent serious permanent impairment and even the complete loss of sight, and what is almost equally important, they can fit these children for useful occupations in later life by the relatively simple expedient of having these children use their eyes most carefully and by supplying them with well designed lighting. From the very first day these children are taught good seeing habits and these habits are so carefully and thoroughly in-

stilled in these children that in later years they can hardly be made to use incorrectly placed light or to otherwise abuse their eyes. This accomplishment speaks for the effectiveness of proper light and eye usage when it becomes a habit. To-day poor lighting is a habit even though we naturally choose from 50 to 500 footcandles for ordinary reading when so tested. Still one, two and three footcandles abound in the great mass of homes for all seeing purposes, whether it be for fine type, large type, poor paper, darning socks, or any other of the common tasks. Only the Science of Seeing applied daily to the habits of our youngsters can bring about a change. They will be started on the right road and the parents of these children will teach themselves while they are teaching their children.

# The Language of Lighting

(*From General Electric Company Home Lighting Course*)

ONE, entering the lighting sales field, is suddenly confronted with a terminology with which he is unfamiliar, and definitions which may have at one time had some vague meaning or even have been understood when taking Physics in high school, but which now appear formidable and rather discouraging.

Truly it would be ideal if every lighting salesman or saleswoman regardless of the field of operation, were conversant with all of the terms and technicalities applying to lighting and electricity, however, that is not necessary to the successful sale of lighting. There are a few that should be known and understood, especially those that must be used time and again in the sales presentation. It is the purpose of this talk to explain these few and to put them in a language that can be used when necessary to visualize them to the customer.

CANDLEPOWER. Many people have a misconception of the term candlepower, particularly since some of the early carbon lamps were rated in candlepower—16 c.p. or 32 c.p.—rather than in watts as is now the practice.

Let us look at the meaning of candlepower.

While there are an infinite number of directions from which the eye might look at a light source, the light-giving power, or pressure of light, in *one direction only* is arbitrarily chosen as a basis and called the *candle*. Any change from that one direction gives us another, and perhaps different, candlepower.


*Fig. 1—The candlepower in the direction of the photometer is not changed by partially surrounding the light source with a non-reflecting surface.*

Assume that we have a light source (S) (Fig. 1) which gives 1 candlepower in all directions. We can measure the candlepower in one direction with a photometer. Next, we partially surround the source with a black sphere that absorbs all of the light that strikes it. This has not changed the original candlepower measured; nor will it be changed if we cover up, and absorb, all of the light except that one ray measured. It still measures 1 candlepower. Other sources might have 5, 10 or 100 candlepower in that same direction.

But taking a large number of readings we could measure the candlepowers in all directions around a source, and average them. This would give us what is known as *mean spherical candlepower*. By multiplying this by a factor, $4\pi$ we would obtain a measure of the total light output, or lumens of that source.

LUMENS. If now we lay candlepowers close enough together, we would obtain a solid cone or flux of light, and it is necessary to do this when we consider the objects to be lighted as areas. Assume that a source is giving one candle in every direction, and that this source is placed at the centre of a sphere painted black on the inside and having a radius of 1 foot, as shown in Fig. 2,

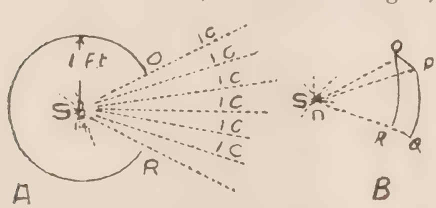



*Fig. 2—A—Opening OR has an area of 1 square foot and emits 1 lumen. B—One lumen falls on surface O P Q R.*

*OR* represents an opening in the sphere through which some of the light may escape. The quantity of light allowed to escape may be varied by varying the size of the opening, with the candle power of the source and the radius of the sphere remaining fixed; if some definite size of opening at *OR* is assumed, a definite quantity of light which may be used as a unit for measuring quantity will result. The simplest area or unit to assume for *OR* is 1 square foot, and it has been established that the amount of light escaping shall be considered the unit of quantity, and it is called a *lumen*. If the area *OR* is doubled, the light escaping will be 2 lumens; if the area of *OR* is made ¼ square foot, the light escaping will amount to ¼ lumen. On the other hand, if there is a source of 2 candles, 2 lumens will be omitted through an opening of 1 square foot in this particular sphere.

A lumen may also be defined as being equivalent to the quantity of light intercepted by a surface of 1 square foot, every point of which is at a distance of 1 foot from a source of 1 candle (Fig. 2 B). While the sphere is used as a basis of definition a lumen of light spread onto a flat surface would produce the same result—1 footcandle over the entire surface.

FOOTCANDLE. Light is a cause and illumination the effect or result. Both the lumen and the candle are used to measure the cause, these units applying to the light source itself and not to the point where the light is utilized. To measure the illumination on a newspaper, desk, or other working plane, there is a unit called the *footcandle*. A footcandle represents an amount of illumination equal

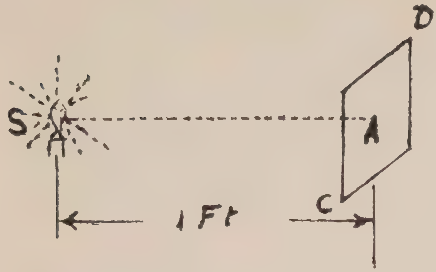



*Fig. 3—The illumination at A is 1 footcandle.*

to that produced at a point on a plane 1 foot distant from a source of 1 candle and perpendicular to the light rays at that point. In Fig. 3, if the source *S* gives an intensity of 1 candle along the line *SA* and if *A* is 1 foot distant from the source, the level of illumination on the plane *CD* at the point *A* is 1 footcandle.

The level of illumination measured in footcandles, is the measurement most intimately associated with everyday use of light, and a measurement which the eye either consciously or unconsciously is making whenever the faculty of vision is being employed, for the number of footcandles there are on the working plane, other things being equal determines directly whether or not there is sufficient light. A working idea of a footcandle of illumination may be obtained by reading a newspaper for ten minutes with the paper held approximately one foot away from a candle. At first the illumination may seem adequate but the observer soon wishes for more light.

Care should be taken to avoid confusing the amount of illumination on a surface, as indicated by the footcandles, with the appearance as regards brightness of the surface. A dark gray surface lighted to an average of one footcandle will not appear as bright as a white one, for a greater proportion of the light falling upon the surface is absorbed and lost. The brightness of an object depends upon both the intensity of illumination on it and the percentage of light that it reflects.

Since the facility with which objects can be seen depends upon the amount of light they reflect, high levels of illumination must be provided where the materials worked upon are dark in colour.

Having defined the footcandle as a unit of level of illumination, the next point of interest is in seeing how the footcandles of illumination vary as the candlepower of the source varies, and also as the distance of the plane from the source varies. It is obvious that if in Fig. 3 instead of an intensity of 1 candle along the line *SA* there is an intensity of 2 candles, the illumination at *A* would be twice as great, and if there is an intensity of 5 candles the illumination at *A* will be five times as great.

With a source of 1 candle as shown in Fig. 4, the intensity of illumination on *A*, which is 1 foot distant, is 1 footcandle. If, however, the plane *A* is removed and the same beam of light that formerly intercepted by *A* is allowed to pass on to the plane *B*, 2 feet away, this same beam of light would have to cover four times the area of *A*, and the average illumination on *B*, 2 feet away, would be one-fourth as great as that on *A*, 1 foot away, or one-fourth of a footcandle. In the same way, if *B* also is removed and the same beam allowed to fall upon plane *C*, 3 feet away from the source, it will be spread over an area

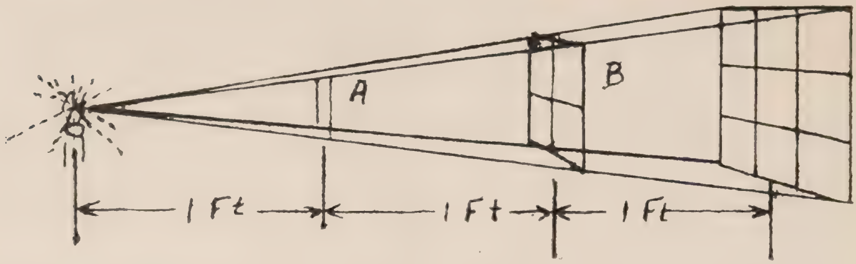



*Fig. 4—The illumination on a surface varies inversely as the square of the distance from the source to the surface.*

nine times as great as $A$, and so on; at a distance of 5 feet there would be only one-twenty-fifth of a footcandle. From this it may be concluded that the illumination falls off not in proportion to the distance, but in proportion to the square of the distance. This relation is commonly known as the *inverse square law.* A simple demonstration of this can be obtained by holding a flashlight 1, 2, 3, and 4 feet from a wall, noting the size of the spot, and measuring with an illumination meter.

This principle also comes actively into play in the distance between the book or paper one is reading, or the sewing which is being worked on, and the portable lamp furnishing the illumination

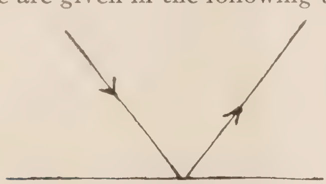
REFLECTION. If we direct 100 c.p. or 100 lumens against an ordinary surface, such as a room ceiling, some is always absorbed and the rest reflected. The percentage reflected is called the reflection factor. A few of these are given in the following table:

REFLECTION FACTORS OF PAINTED SURFACES

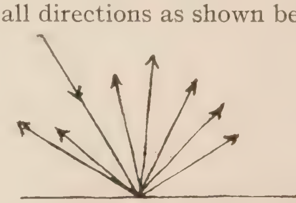
| | |
|---|---|
| White | 80% |
| Ivory | 70% |
| Buff | 65% |
| Sage Green | 40% |
| Sky Blue | 35% |
| Olive Green | 20% |
| Cardinal Red | 20% |

It can be seen, then, that where indirect fixtures or portables are used, and where they depend upon the ceiling and side walls to reflect the light to the rest of the room, those colours with a high reflection factor are much better than the darker ones as more footcandles will be obtained for a given expenditure of wattage. Also, reasonably light colours on the walls of a room assist in the actual production of footcandles on the work as well as other atmosphere effects discussed later.

Surfaces with a glossy surface reflect light after the fashion of a mirror; dull or mat surfaces reflect light in all directions as shown below.

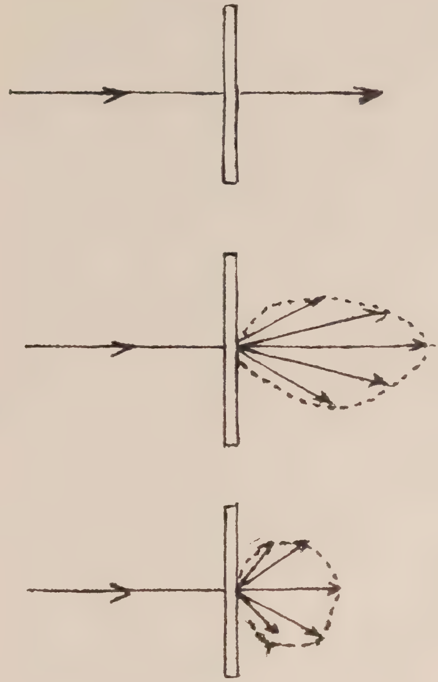


*Light Reflection from a Polished Surface.*



*Light Reflection from a Mat Surface.*

*Fig. 5*



*Clear Glass—no diffusion—does not conceal lamps or reduce glare.*

*Frosted Glass—little diffusion—inadequate concealment of lamps—spotty effect.*

*Diffusing Glass or dense parchment—diffuses the light—conceals lamps—uniform brightness.*

*Fig. 6*

The chief difficulty encountered with polished paints, papers, or objects upon which one is working is caused by the mirror-like reflection of the light from the lamps—which might otherwise be shielded and out of sight—into the eyes. These reflections, especially if coming from the work, constitute glare which in turn reduces seeing, and produces discomfort.

A good high reflection factor is desired on the inside of portable lamp shades in order that the light may be reflected to the work.

Transmission. Light is transmitted through glass, parchment, silk, etc., with several degrees of diffusion depending upon the character of the medium.

Particularly, because of the necessity for the concealment of the lamps in shades and enclosing globes, we are interested in the character of the transmission. If a beam of light is directed against three kinds of glass, clear, frosted, and opal, the way it is transmitted is shown in Fig. 6.

Because the shades of many portables are used so close to the line of vision, many of them are made denser than just enough to obtain complete diffusion so that the total amount transmitted will be low enough so as to not cause glare.

Size of Light Source. If we are walking out of doors on a day when the sun is shining brightly, we note that the shadows we cast on the street are black and have sharp edges.

We note also that we squint more and are more liable to experience uncomfortable seeing conditions.

When, however, the sky is over cast, the sun is concealed, and we have the entire sky as an extensive light source, the shadows almost disappear and we have comfortable conditions for seeing.

The difference between these two is largely in the area of the source of light—in one case the sun, in the other the entire sky area.

We have essentially the same conditions as the result of interior lighting. If the only light source is bare bulbs in the centre of the room, we have harsh shadows and discomfort. Where the entire ceiling is the source of light, such as would be obtained where indirect ceiling or portable lamps, or semi-indirect ceiling units, are used, we have soft pleasing shadows and more comfortable seeing conditions.

Even where portables are used to direct high levels of illumination on our books or sewing, they should be supplemented by other light sources whose function it is to provide general atmospheric lighting and cheerfulness, and to reduce uncomfortable contrasts between the light on our work, and the surroundings.

Furthermore it is of advantage to have as large shades, and enclosing globes as are consistent with good practice and appearance, because the larger they are the softer the shadows, the lower the intrinsic brightness, and thus the more comfortable the seeing conditions.

POSITION OF LIGHT SOURCE. If we turn again to the bright sunny day out of doors, we find that when the sun is shining brightly, it is most comfortable when it is directly overhead, and least comfortable when it nears the horizon. If it happens to be reflected from water or snow it becomes even more trying. The differences are in its position in our field of view.

Look at the applications of these findings to home lighting.

Wall brackets are used by some to furnish working illumination. In general, however, their best use is for decorative purposes only and then when shaded so that the brightness is very low.

Shades on portables, because of their proximity to our normal line of vision, should not only conceal the lamps, but be dense enough that their brightness is low.

Put the eye shades on the lamps and not on our eyes.

CONTRASTS. If the headlights of an oncoming auto are lighted in the daytime we hardly notice them, but the same ones at night might be very disagreeable. The difference is a matter of eye accommodation to surroundings and contrasts. Briefly, we can stand for higher brightness shades and enclosing globes in a light coloured, and well lighted room than in one with dark paper and surroundings. As mentioned before, a single portable might furnish sufficient illumination on our book or work, but still the reading conditions might not be at their best. Usually it is most comfortable when the illumination in the remainder of the room is at *least one-tenth* of that on our work. For example, if our reading lamp produces 40 footcandles, the rest of the room should be lighted to at least 4 foot-

candles. In some lamps the direct (40) and the indirect (4) can be supplied from one lamp; in other cases additional light sources are necessary.

GLARE. This is defined simply as light out of place—light in the eyes that should be on the work or elsewhere.

Glare causes many people to appraise their lighting system as having "too much light". We know that with more and more footcandles *on our work* we see *more and more*, and conversely that more and more glare *in our eyes* makes us see *less and less*. Some call the first, *positive light* and the second, *negative light*. In our search for more footcandles we can never overlook glare as it is a detriment to seeing and after all our obligation to our consumers is to assist them in enjoying their homes more and in making it possible to better carry on the seeing jobs that are a part of normal home life.

# Closing Address

**By G. J. Mickler, Sales Department, H.E.P.C. of Ontario**

WE have now come to the close of one of the most unique institutions ever held in Ontario, a public School of Lighting, and also one of the most successful in the experience of those who conducted the School.

In sponsoring a School of Lighting for the education of those who can spread the gospel of Better Light for Better Sight, the Commission has opened the way to those engaged in the manufacture and sale of equipment to increase the sale and use of lamps and other means of improving illumination; also to those interested in the improvement of seeing conditions, through the educational instructions which have been given at this school, and a means for improving general seeing conditions for the preservation and improvement of our eyesight.

That this School has been an immediate success is measured by the numbers who have attended. Registrations indicate that the following attended one or more sessions of the School:

| | |
|---|---|
| H.E.P.C. Engineers | 45 |
| Municipal Hydro Representatives | 101 |
| Lamp Manufacturer Representatives | 20 |
| Equipment Manufacturer Representatives | 62 |
| Jobbers | 27 |
| Fixture Manufacturer Representatives | 17 |
| Contractor Dealers | 56 |
| Department Stores Representatives | 20 |
| Electric Service League Representatives | 4 |
| Architects | 3 |
| Optometrists | 4 |
| Publications Representatives | 5 |
| Teachers | 8 |
| Students | 20 |
| Miscellaneous | 25 |
| | 417 |

There was an average attendance at

all of the sessions of approximately 225 and I am sure that a lot of persons attended meetings who did not register. I am safe in saying that over 500 persons received some benefit from the instructions which were given, all of which indicates the interest in the subject of Lighting and the anxiety and desirability for securing more intimate knowledge of how to treat it.

The ultimate success of the School, of course, depends upon the application which those who have attended it will make of the information they have gathered, the instructions they have received and the literature they have been supplied with. You have heard by word of mouth, you have seen by actual demonstrations, and you have had a chance to read things which should convince you all that there is a vast field lying ahead of those who want to take advantage of the opportunity to improve seeing conditions in almost every phase of human activity. We want you, when you leave this School, not to tuck away into some corner of your desk, or your pocket, or your brain, the information that has been imparted to you here. You should bring it out repeatedly, look at it, read it and think it over and use your best endeavours to put the principles which have been laid down as fundamental into operation, if not for your own material benefit, for the good of humanity.

Let us see who will receive the benefit of this School:

First of all, those who are directly engaged in selling lighting will receive the first benefit; that is, if they can sell something to produce better illumination. They are the first ones to reap any profit because of their employment.

The second one to profit by the activity which this School will create is the manufacturer of equipment, such as lamps, reflectors and bulbs, to produce better illumination.

And there is the consumer, or user of the light, whose eyesight is going to be improved, whose health is going to benefit and the general well-being of his family profit by the improvement in seeing conditions in the home, the office and the factory.

After all of these have shared in the benefits of the instructions which have been given here, the Hydro perhaps will supply an increased amount of electricity to bring all this about. In a sense the Hydro does benefit, but in so doing these benefits are passed on to our consumers in the form of better service at lower rates.

The success of this School, however, is due entirely to those who have stood before you for the past four days and have unfolded to you the principles of proper seeing, proper light for proper seeing and have told you how to carry on for the good of humanity. And I would like if those who have taken part in this School would rise as I call their names and receive the applause which they deserve for the untiring way in which they have performed their various tasks:—Mr. Walter Sturrock, Mr. S. M. Litscher, Miss Ruth King, Mr. A. Reas, Mr. J. W. Bateman, Mr. Art Nichols and troupe, Miss Eleanor Potts, Mr. R. M. Love.

Our sincere thanks are due also to the Canadian General Electric Company, who has made this School pos-

sible, and I would like to extend to Mr. Sweetman our appreciation of his efforts and co-operation in providing such a splendid educational medium.

I wish to thank the Management of the Royal York Hotel for the splendid co-operation, not only for providing such commodious and elaborate quarters for the conducting of the School, but for the service which all members of their staff have rendered as well.

This School marks the beginning of an activity which the Hydro-Electric Power Commission is sponsoring for Better Lighting. Plans are being laid whereby local Lighting Schools may be formed and experts travel from place to place as a follow-up to the activity which this School has inaugurated.

I want to thank you all for the very, very attentive way in which you have attended these lectures. It has been a great inspiration to the Hydro and an encouragement to continue this sort of work, and I hope that this School will be but the first of similar Schools which may be held in the future. I hope when you return to your homes that you will do as I said before, start immediately to put into effect the things you have learned, improve the conditions of seeing in your own homes. You cannot hope to sell better lighting to others until you have shown to them that you believe the gospel that you are preaching and practise it. Tell your friends about it, your neighbours, your storekeepers, your school teachers, and you will be surprised how soon everyone will become conscious of the fact that their eyes need looking after and the rewards to us all will follow.

# Hydro Electric Range Campaign

A PROVINCE-WIDE electric range campaign, sponsored by the Hydro-Electric Power Commission of Ontario and supported by all the other branches of the electrical industry in Ontario, was launched on Monday, April 15th, 1935. This campaign will be carried on vigorously for a three-months' period, or until July 15th.

Earlier in the month letters were sent to every Hydro utility, which outlined the bases of the campaign and asked that each co-operate with the other utilities and with the Commission in conducting it. A draft of resolution to be used by the municipal commissions to signify their willingness to take part in the campaign was enclosed with each letter.

As an inducement to purchasers of new electric ranges during the campaign, the local utilities are asked to make a campaign allowance up to a prescribed maximum limit. This will be considered as a load building allowance.

Some co-operating municipalities will finance the sale of ranges made by reputable dealers to customers whose credit is approved by the local commission, over a period of time. This will be done in some cases whether the municipality is operating a Hydro Shop or not. The payment period will be from one to five years,

with an endeavour to limit it to three years. The rate of interest or financing charges to be set up by the local commission and to be added to each contract will be governed by local conditions, but will not exceed 6 per cent. per annum on the unpaid balance. Recommendations are made that the cost of wiring, where new three-wire services or range connections are necessary to accommodate electric ranges, should also be financed over a period of time, unless all or some of the cost is absorbed by the municipality. The rates for financing wiring costs and the term of years will be governed by local conditions.

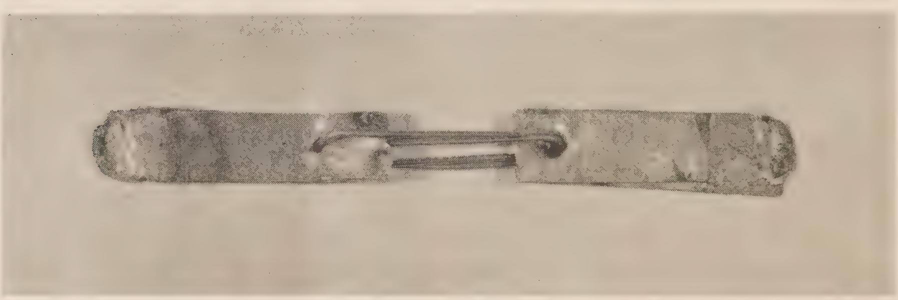
Each co-operating municipality will carry on local advertising during the campaign. The Hydro-Electric Power Commission will assist the municipalities in this advertising by supplying advertising material in the form of newspaper cuts and general display material. The Commission will also make a direct contribution to the dealer, contractor or Hydro Shop for each new electric range of 50 amperes capacity or over, sold and installed by such retail outlet during the period of the campaign. The Commission will supply each co-operating municipality with a complete sales manual for the use of each salesman and an organization manual with full instructions and suggestions on how to conduct a local campaign. Also representatives from the Commission will be sent to each municipality to help in local organization work and to give any other assistance that may be necessary to make the campaign a success.

It is intended that the activity of this campaign will be continued throughout the summer months and will be followed by another intensive effort in the fall.

It is hoped and urged that every Hydro municipality will become a party to the campaign and co-operate to the fullest extent in the effort. Every range sold and put into service will add to the load of the municipality as well as to that of the Commission and will benefit the consumer, the utility and the Commission.

"HYDRO IS YOURS—USE IT."

To date, 63 municipalities have signified their intentions of co-operating in the campaign—send in your resolution NOW.



*Fuse (?) discovered in a 3 phase motor circuit by N. E. Wilson, Superintendent, Amherstburg.*

THE

# BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year


## Ottawa Hydro's New Home

OTTAWA Hydro-Electric Commission has erected a new office building, located on the south-east corner of Albert and Bank Streets, which was formally opened on Thursday, May 9, 1935, by T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario. Mayor P. J. Nolan, Chairman of the Ottawa Hydro-Electric Commission, presided and introduced Mr. Lyon. Following a brief address, Mr. Lyon stepped up to the double cashier's wicket on the main floor and cut two white ribbons which had been stretched across the aisles leading to the wickets, declaring the new quarters open for the local Hydro. Members of the Ottawa Commission and Board of Control then went to the wickets and each conducted a brief transaction with the cashiers. After the opening ceremonies the guests were taken through the building, visiting all floors.

The building has a frontage of 67 feet on Bank Street and a depth of approximately 50 feet. It is three-stories high with provision for adding a fourth.

The design of the building, both exterior and interior, is in accordance with the modern trend and depends mainly upon proportion and material for the desired effect. Historical architectural features of design and ornament have been carefully avoided and the orientation handled with restraint.

In planning the building the Ottawa Hydro-Electric Commission had in mind a building which would house the office and sales staff of the commission only. No additional space for rental purposes has been provided. Construction of the building was commenced in July, 1934.

A show-room for the display of electrical household appliances occupies the front half of the ground floor with large show windows, fronting on both Bank and Albert Streets. The show-room also serves as a lobby or rotunda for the building. An interesting feature of the show-room is the fireplace for the display of electric fireplace units. The combination of Botticino, Silvertone Black and Green Levantine makes a striking effect.

Opposite the main entrance doors are the cashiers' cages constructed of bronze with double wickets and guide

## CONTENTS

Vol. XXII No. 5

MAY, 1935



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

rails to facilitate the handling of customers when paying bills. On one side of the cage is the sales counter, and on the other side are the stairs and elevator. The counters are of Silvertone Black marble with steel filing cabinets occupying the space under the counter.

The stairs are of steel with continuous aluminum hand railing and marble treads. The elevator cab is a modernist design in black enameled steel with chrome trim and inlays of red.

Back of the cashiers' cages is the general office space and the secretary's private office.

Vaults are provided on each floor for the storage of records. Each vault is equipped on all sides with steel shelving.

On the first floor are located the accountants' offices with a private office for the chief accountant. A separate room is provided to house the typewriters, adding machines, etc.

Locker rooms and toilet accommodation are also provided on this floor.

The second floor is devoted to the executive offices for the general manager, assistant manager, the board room and a general office. Special interest centres around the board room with its extremely modern fireplace, flexwood inlay wall treatment and plaster ornament.

Marble is used to advantage for wall and wainscott treatment, cream Botticino being predominant. The trim throughout is Silvertone Black marble which is a local product quarried at St. Albert by an Ottawa company.

Ceiling panels are of acoustic tile on the ground floor and acoustic plaster on the top two floors. This treatment absorbs excessive noise and makes the offices quiet and peaceful, with the result that the staff can work much more efficiently without nervous strain.

Features worthy of special note are the bronze and aluminum grilles in modern design which protect the show windows, entrance doors, cashiers' cages, radiators, etc.

Considerable interest was shown by those visiting the building in the finish on the walls of the executive offices. This is a very thin veneer mounted on canvas and gives a rich and pleasing finish.

The building is entirely fireproof, no wood of any kind being used in its construction.

The structural frame is of steel. The floors are constructed with steel bar joists, and concrete slabs finished with linoleum tile, except the showroom floor, which is Travertine marble.

*Part of public office showing cashier's wickets, Ottawa Hydro.*

Outside walls are of cinder concrete blocks and faced on the street fronts with Deschambault stone.

A departure from the usual method of heating has been adopted for this building. An electric steam generator has been installed with an auxiliary oil burning boiler. During the off-peak periods the heating will be done by electricity without extra cost to the Hydro-Electric Commission. The oil burner will only be used during the peak load periods. Steam is distributed through the system under differential vacuum control operated by thermostats at different points in the building. Radiators are of the concealed type in wall recesses.

A system of air conditioning has also been installed. A supply of fresh air is brought in from above the roof and is washed, humidified and heated before delivery to the various rooms.

Provision for cooling by refrigeration in the warm weather has also been provided.

All the mechanical apparatus is entirely under automatic control.

A transformer room is provided within the building where the power is brought in at 2,200 volts and stepped down by a series of transformers to 550 volts for the power circuits and to 110 volts for the lighting circuits.

Following the opening and inspection of the building there was a dinner at the Chateau Laurier. This was attended by members of the Ottawa Hydro-Electric Commission and commission officials, members of the City Council, civic department heads and many other prominent citizens. Mr. Lyon was the guest of honour.

The members of the Ottawa Hydro-Electric Commission are — Mayor P. J. Nolan, Chairman and Dr. Rufus H. Parent and Hammet P. Hill, K.C., Commissioners. The Manager is John E. Brown, the Assistant Manager, Stanley W. Canniff, and George E. Pennock is the Secretary.

## W. R. Parker, Penetanguishene.

*William Robert Parker*

One of the most respected and outstanding citizens of the Town of Penetanguishene, in the person of William Robert Parker, passed away suddenly on Sunday, April 21, 1935, in his seventy-first year.

Mr. Parker was an important public figure in the affairs of the town, and held most of the offices pertaining to its municipal government. At the time of his death he was Secretary-Treasurer of the High School Board and also of the Water and Light Commission. This latter position he held for the past twenty-three years, since the formation of that Commission in July, 1911, when Penetanguishene began taking Hydro power. He was Secretary-Treasurer of the Fire Department and the Public School Board, and Chairman of the latter body. He also filled the post of Assessor and Collector of taxes. His solid integrity and thoroughness in the discharge of his official duties earned him the complete respect and whole hearted confidence of those with whom he came in contact.

He is survived by his widow, eleven children and twenty-one grand-children, to all of whom we extend our sympathy in their bereavement.

# Attorney-General's Address

## Deals With Hydro's Great Problem

### Honestly, Exhaustively and Faithfully

THE problem of Hydro's annual deficits and the increasing cost of power, the result of improvident contracts for the purchase of Quebec power was reviewed at length and with great wealth of detail in the Ontario Legislature during the session which has just closed. In a speech which struck hammer blows at what he termed an iniquitous proceeding, the Honourable T. B. McQuesten, Minister of Public Works and Hydro Commissioner, expressed his approval of the accuracy and comprehensive thoroughness with which the Attorney-General had presented the Hydro case. Following the debate in the Legislature, Mr. Roebuck turned directly to the power-users and the people of Ontario generally, and in four radio addresses laid the facts in condensed form before the people of the Province.

The following are Mr. McQuesten's remarks:

"May I congratulate the Honourable the Attorney-General on his splendid presentation of the situation of the Hydro enterprise which he has just made to this House? I venture to say that seldom in the annals of the House has there been a more eloquent, more comprehensive and a more forceful deliverance on a question so vital to the economic life of the Province and the private life of the citizens. This House is fortunate in having as its chief representative on the Hydro-Electric Commission of Ontario a man of the outstanding ability of the Honourable the Attorney-General, not only in his wide experience and mental equipment but in his capacity to present to this House and the people of this Province this issue in a most masterly way. May I say further that the business of the Hydro-Electric Power Commission in all its ramifications is a business of immense proportions and one which involves much highly technical knowledge. It requires the most studious application to be able to come to a working knowledge of it and mental qualities of no mean order. This House must, to a large extent, be guided by the confidence which it has in its representatives on this Commission, as it is obviously impossible for the individual members to give the time necessary to become familiar with the operations of the Commission. May I say to you that I have gone over much, if not all, of the data before the Honourable the Attorney-General in the preparation of his conclusions which he has announced to you. He has dealt with it honestly, exhaustively and faithfully in the sense that he owes to this House which is depending upon his guidance, the duty of painstaking care and deliberation in reflecting in his statements and conclusions the fair result of the material to which he has had access, and in the sense that he owes to you and to the people of this Province the duty of reviewing the operations of this most important Commission and counselling you as to the course which they should follow in the future.

"I regard the address of the Honourable the Attorney-General as a most complete review of the history and the data respecting the transactions to which he refers. I agree with his presentation of them and with his conclusions. I do not think I can add anything especially useful to the debate in the way of a repetition of the shameful history of the wrecking of ths great Provincial Institution, surely the most shameful episode in the Province's history of callous, calculated, cold-blooded betrayal of the interests of the people for private and party advantage."

# Crisis in the Affairs of Hydro

## Eastern Power Contracts Cause Serious Crisis in Hydro Affairs

FOUR ADDRESSES ON THE SUBJECT OF THE PURCHASE OF UNWANTED POWER IN HUGE QUANTITIES FROM QUEBEC POWER COMPANIES WERE BROADCAST BY THE HONOURABLE ARTHUR W. ROEBUCK, K.C., M.L.A., ATTORNEY-GENERAL OF THE PROVINCE OF ONTARIO AND COMMISSIONER OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO OVER RADIO STATION C.F.R.B., ON MARCH 26, 27, 28 and 29, 1935. THE FOLLOWING IS THE TEXT OF THE ADDRESSES.

### PART ONE

LADIES and gentlemen of the unseen radio audience. A crisis of great magnitude has arisen in the affairs of the Hydro-Electric enterprise of Ontario. As a result of a series of transactions, which it is my intention to describe in the course of this series of addresses, the Niagara System has been mulcted in the cost of huge quantities of unused power, so that prices to the consumer have been drastically advanced and the system itself has been penalized in a series of heavy deficits. Its reserves are being rapidly depleted and its future position is a matter of grave concern. Under these circumstances, I have determined to lay the facts before the power-users and tax-payers of the Province of Ontario and to ask for your advice in the solution of the difficult problem which faces the Hydro-Electric Power Commission and the Government of Ontario.

This is your business, and it is right and reasonable that you should be consulted. I ask you to note the facts and figures carefully as I lay them before you and then to write me your conclusions, so that the wisdom of many minds may result in a just and courageous conclusion.

May I indicate to you the importance of the problem I am bringing to you for solution. The Hydro-Electric enterprise of Ontario has capital investment in plant for all systems of $285,000,000. It is the third largest public utility in Canada and its investment is exceeded only by the C.N.R. and the C.P.R. It has very nearly double the investment of the Bell Telephone Co., with all that Company's ramifications from coast to coast. Hydro has 621,000 customers.

The success of this great institution means low cost of light in the homes of our people and on the streets of our municipalities—cheap and abundant power in our manufacturing and commercial institutions and a consequent advantage in production which will enable our business to compete successfully with less favoured industry abroad. Wisdom and honesty means the safety of an investment of such great magnitude as to vitally effect the financial stability of our province, while on the other hand, stupidity or worse such as has characterized the management of Hydro in the past means losses in millions —a sacrifice of commercial advantage accentuating the stagnation and unemployment of our present depression and resulting perhaps in still further burdens to the tax-payers.

One recalls with admiration the foresight and public spirit of the early founders of Hydro. They pictured the waterpowers of Ontario publicly owned, developed and operated, distributing energy for light into every home and on the streets of every hamlet, and power to every factory and farm. "Power at cost" was the slogan, and they saw in cheap power the low production costs which would build up a great industrial population in Southern Ontario, with its rich harvest of prosperity and employment, and of comfort to many thousands of our fellow-citizens. This was the vision of Hydro. Had it not been betrayed, cheap power might have done much to avoid the wide-spread unemployment and stagnation which has befallen the people of the Province.

How bitter are the fruits of that betrayal, I can indicate to you with a few round figures.

### Shortages Charged Against Contingencies

In the short time in which the present Commission has held office from the 10th of July until the close of the fiscal year on the 31st of October last, the Commission has reduced its executive salaries by $98,000 per year, and has cut down its general expenses by approximately $1,000,000 per year. By a vigorous policy of promotion, it has succeeded in increasing somewhat its sales of power. Notwithstanding these facts, however, the deficit in the Niagara System for the year ending the 31st of October, 1934, was $2,870,000. In 1933 the deficit was $4,237,000, and for the previous year of 1932 the deficit was $2,545,000.

In these figures there is no charge for obsolescence or contingencies, and no sinking fund on the Chats Falls and Decew developments and the Hamilton steam plant. These heavy losses have been charged into the obsolescence and contingency account, a fund which the Commission has for many years been building up to meet inevitable depreciation in the value of machinery due to advance in invention and design, and various other inevitable but unforeseen occurrences. In 1931 obsolescence and contingencies reserve stood at $14,632,000. In 1932 it had been depleted to $12,443,000. In 1933 it was $9,109,000, and by the end of 1934 it had shrunk to $6,526,000. At this rate of decrease this great fund will be entirely wiped out in the course of the next two years. Alarming as these figures may be, they present but one portion of the picture. The average cost of power supplied to the municipalities and direct power consumers has increased to a point where steam generation is an actual potential competitor.

### Cost of Power to Niagara System

Without charge for obsolescence and contingencies and without withdrawal from that fund, the Commission's average cost of power supplied to the Niagara System during 1934 was the astonishing figure of $29.68 per h.p. per year. In 1929 the average cost was only $20.03. The 1934 cost is therefor almost one-half as much again as the 1929 cost. Unbelievable as it may sound in a Province so plentifully endowed with magnificent water-powers, the power rate has been increased by approximately $10.00 per h.p. per annum in the last five years.

The Commission has not charged its customers the full cost of its power, however, for to do so would have revealed to the voters the true extent of the Hydro disaster and might have resulted in steam competition. We have been drawing on our reserves.

In 1929 the average cost of power was, as I have said, $20.03. We placed $3.67 per h.p. in our obsolescence account and charged $23.70. In 1930 the cost was $20.84. We placed $3.24 in this reserve account and charged $24.08. In 1931 the effect of the purchases from Quebec commenced to be apparent. The cost was $23.31. We placed 61c. only in the contingency reserves and charged $23.92. In 1932 the cost had risen to $27.49 and we withdrew from our reserves $2.97 per h.p. in order to reduce the charge to $24.52 per h.p. In 1933 the cost had risen still further to $31.20 and we withdrew $5.43 from our reserves for every h.p. which we sold and we charged the municipalities an average of $25.77. In 1934 due to reduced expenses and slightly increased sales, the cost of power was $29.68. We withdrew $3.51 per h.p. from our reserves and charged $26.17.

There are those in our municipalities who complain rather bitterly at the high cost of electric power. What would they have said had the Commission charged the true cost? In Toronto in 1934 we charged $26.13 per h.p.; the actual cost was $30.85. In Hamilton we charged $25.12 per h.p.; the true cost was $29.84. In Brantford we charged $26.80; the cost was $31.52. In London we charged $26.81 and the cost was $31.53. In St. Thomas we charged $28.38 and the cost was $33.10. In Kitchener we charged $27.19 and the cost was $31.91. Our average charge through the Niagara System was, as I have said, $26.17 and our average cost was $29.68.

### Power Purchases From Quebec Companies

The explanation of this drastic increase in power costs is to be found in a series of improvident purchases of unwanted power from four generating companies located in the Province of Quebec. From the Gatineau Power Company we purchased 260,000 h.p., payable in American funds at $15.00

per h.p. at an actual cost in 1934 of $3,865,-000. From the Beauharnois Light, Heat and Power Company we purchased 129,000 h.p. maximum at an actual cost of $1,193,-000. From the McLaren-Quebec Power Co., we purchased a maximum of 40,000 h.p. at an actual cost of $400,000. From the Ottawa Valley Power Company we purchased a maximum delivery of 96,000 h.p. at an actual cost of $1,096,000. We paid out to these four companies the sum of $6,553,000, and the total cost, including the annual charges on the Gatineau transmission lines and the Leaside and Bridgeman transforming stations, was $8,356,000. We have paid to these four companies since the contracts commenced to the 31st of October, 1934, for unwanted or practically unwanted power, the huge sum of $25,-000,000.

### Hydro's Own Plants Adequate

I have said practically unwanted power. May I make my meaning clear? The Hydro-Electric Power Commission owns three plants on the Niagara River with a normal operating capacity of 830,000 h.p. At the present time, the water is low in the Niagara River so that the engineers have made a more conservative estimate and reduced the rating to 810,000 h.p. We have contracted to accept from the Canadian Niagara Power Company 10,000 h.p. and to this is to be added 96,000 h.p. from the Commission's own plant at Chats Falls, making a total in all of 916,000 h.p. Now the maximum demand last year on the Niagara system for firm or uninterruptible power was 833,000 h.p. This is a twenty minute peak in the afternoon of a dark day in midwinter. That is to say, without any Quebec power we had at the years peak, or point of highest demand, a surplus of power within our own system of 83,000 h.p. sufficient to cover loss by leakage in transmission and to provide a modest reserve. Yet in spite of this, we actually purchased from the Quebec companies and paid for as much as 525,000 h.p. at a cost price paid of $6,553,000 and an actual cost with transmission included of $8,356,000. From our point of view, this was wealth thrown into the sea.

### Quebec Power Commitments Increasing

But bad as is the past, the future is even worse. These so-called contracts presumably obligate us to accept power in increasing amounts from time to time until the year 1937. From Beauharnois last year we received a maximum delivery of 129,000 h.p., but the full contract is 250,000 h.p. From McLaren-Quebec we received a maximum of 40,000 h.p., but the full contract is for 125,000 h.p. Figuring the Chats Falls delivery on the actual payment of the past year, which was reduced owing to low water, we will pay during the current year of 1935 to those four companies a further $1,200,000 per annum. And still the story is not told, for in 1936 we will pay in purchase price $8,930,000, at a total expense, transmission included, of $10,293,000, and in 1937 and thereafter we will pay $10,965,000 at an approximate expense of $12,000,000 per annum.

Worked out from the beginning to the conclusion of their contracts, these four companies are entitled to take from the people of the Niagara district a gross in payments of some $380,000,000, or approximately $100,000,000 more than the Commission's entire investment in its physical plant, all systems included.

### Heavy Losses Anticipated

These are indeed serious figures, but let us endeavour to estimate on some basis of calculation what effect they will have upon the financial resources of the Niagara System. To accomplish this, one must assume some basis of calculation. If for the next three years the expense of operation should remain the same and if the consumption of power should not substantially increase, what then will be the effect on the balance sheet of the Niagara System? In 1934 the deficit was $2,870,000. On this basis of calculation, of no decrease in expenses and no increase in sales, the deficit for the current year of 1935 will be $4,000,000. For 1936, on the same basis, the deficit will be $5,500,000. In 1937 it will be $6,900,000 and in 1938, when the sinking fund, now suspended, of the Dominion Power and Transmission Company purchase is added, the deficit on that basis will be over $7,000,000. Now in this connection, remember that the obsolescence and contingency reserves are already reduced to $6,500,000.

### Anticipated Growth in Demand

Of course, you will note that this basis of calculation may not be correct. I agree

with you. We will reduce expenses, although the larger reductions are already effected, and in all human probability we will increase the sales of power. This latter prospect, however, should not be overrated. Hydro commenced business in a virgin field. Its rapid growth in previous years was due to additions to the System of new municipalities and new individual customers. It started with thirteen municipalities and it now serves 760 municipalities. It absorbed the plant and customers of the Toronto Electric Light Company, the Dominion Power and Transmission Company of Hamilton and quite a number of other private concerns. There are in Ontario to-day practically no competing companies to absorb, and a few rural municipalities only to add. The growth in rural consumption last year over 1933 was only 2,270 h.p. as at the August peak. Growth in the future must therefore depend for the most part on the increased demand of municipalities already in existence, together with increased commercial and manufacturing requirements due to such activity as might follow a change in trade conditions. Past growth is not a reliable criterion upon which to gauge future expansion.

There will be improvement, I am convinced, in both power sales and in reduction of expenses, but remember, our revenue this year was less than $22,000,000 and we are obligated to pay as of 1937 very nearly $10,000,000 for power from these four companies, or almost one-half of our entire revenue.

When deliveries of purchased power have reached their maximum in 1937, we will have 1,647,000 h.p. on the basis of our present generating capacity plus purchased power. Our present requirements on the basis of 1934 peak are 833,000 h.p. for firm power so that while our requirements do not increase we have over-purchased by 724,000 h.p. or practically double our present requirements. Unless it can be reasonably expected that the consumption of electrical energy in the Niagara System will nearly double in the next few years, the people of the great industrial portion of our Province may look forward to excessively high rates, together with heavy financial losses for a good many years to come.

### Summary of Hydro Facts

Let me summarize these startling facts as I have presented them to you.

We have available from the Niagara River, a supply, at present of 820,000 h.p. To this is to be added 96,000 h.p. from the Commission's own plant at Chats Falls, on the Ottawa River, making a total of 916,000 h.p.

The highest maximum firm demand for the entire year just past was 833,000 h.p., leaving a surplus of 83,000 h.p. at the time of the years peak to allow for transmission leakage, and to provide a small measure of reserve power.

Over and above that 83,000 h.p. surplus at peak within our own system, we purchased from the four power companies of Quebec, 731,000 h.p. at $15.00 per h.p., or a total of $10,965,000 per year, when deliveries are complete.

The average power cost in the Niagara district has increased approximately $10.00 per h.p. within the last five years, to a rate of $29.68 per h.p.

Our deficit last year in the Niagara System was $2,870,000. On the basis of 1934 power sales and operation expense, this deficit can be calculated to increase to $7,000,000 per year, though of course there will be improvement, reducing by an unknown amount that amazing figure.

Our obsolescence and contingencies reserves of $14,500,000 in 1931 are now reduced to $6,500,000, as at the end of the year 1934. At the present rate of absorption, these formerly immense reserves will be completely wiped out in two years time.

There is the problem—now what is the solution? The Prime Minister, the Honourable Mr. Hepburn, has asked me to place these facts before you in order that we may have the advantage of your judgment added to our own. Shall we let this situation continue? Shall we increase our power charges and so destroy industry, so that unemployment and business stagnation shall increase in the Province? Shall we permit recurring deficits to ruin the financial structure which Adam Beck and the founders of Hydro have built up, or on the other hand shall we take action, and if it is action, what action? If you have an opinion now or when these broadcasts are concluded, will you please write me, addressing your letter to the Parliament Buildings at Toronto.

Tomorrow at this same time, I shall lay before you some further startling facts of the gross mismanagement or worse that has characterized the conduct of Hydro during recent years.

* * * *

## PART TWO

### Principles of Beck Ruthlessly Sacrificed to Political Expediency

Ladies and gentlemen of the radio audience. In my radio address of last evening, I told you that the generating capacity of the Hydro-Electric Power Commission's owned plants of the Niagara System (together with 10,000 h.p. under purchase from the Niagara River) amounted to 916,000 h.p., while the maximum peak demand on the system at any time during the past year for firm or interruptible power was 833,000 h.p. This highest demand occurred on a dark afternoon towards the close of the year. Our resources of power from the Niagara River and our own plant at Chats Falls were thus 83,000 h.p. in excess of the firm requirements at the point of yearly maximum demand.

That notwithstanding this surplus in our own system, we have purchased from private companies in the Province of Quebec a total of 731,000 h.p. as of 1937, at $15.00 per h.p., or at a cost to us when deliveries are complete of $10,965,000 per annum. The actual cost last year, (because de-deliveries have not yet reached their maximum amounts) was $6,553,000.

I told you that because of these most improvident transactions the Commission has suffered deficits:

In 1932 of $2,545,000.
In 1933 of $4,237,000.
In 1934 of $2,870,000.

That these recurring deficits have been abstracted from the System's obsolescence and contingency reserves, reducing this fund from $14,632,000 in 1931, to $6,526,000 in 1934.

That, should there be no appreciable increase in revenue or decrease in the cost of operation over 1934, the Commission's deficits might be calculated to increase in consequence of the rising cost of purchased and unwanted power to

$4,000,000 in 1935,
$5,400,000 in 1936,
$6,900,000 in 1937 and
$7,000,000 in 1938 and thereafter.

I told you that the average cost of power in the Niagara System had increased by approximately $10.00 per h.p. in the last five years, and that unless tremendous increases could be effected in the sales of power, further drastic increases in power costs may be anticipated.

And I ask you to write me your advice to the Prime Minister and his cabinet and to the Hydro-Electric Power Commission as to whether you desire us to impose this burden on the light and power users of this Province or whether you want action, and if so, what action.

To-night, I turn to what has been called the great betrayal of the principles of Adam Beck and the early founders of Hydro, and the consequent sacrifice of the Hydro-Electric System of the Province apparently to the political exigencies of those in power at that time.

In this connection it is important that we understand clearly what were the principles of the founders of Hydro and what were the plans by which Sir Adam Beck proposed carrying them into effect.

#### Principles of Founders of Hydro

The primary principle was public ownership. This needs no proving. It was the public ownership of the entire enterprise, beginning with the natural resources of power in the rapids of the rivers where falling water may be utilized in turbines; next, the generating plants by which water power is transformed into electrical energy, and finally, the distribution lines and systems by which electrical energy is transmitted to the ultimate consumer. Public ownership is the primary principle upon which the whole Ontario Hydro-Electric enterprise is founded.

True, as has been pointed out in the Legislature by the apologists for what has taken place and the defenders of the power barons, the procedure in early days was by way of power purchase and public distribution. There was no other practical way to commence. But it is to be noted

that as the distribution system became established, Sir Adam turned to the public ownership of generating plants. He took over both the Electrical Development Company and the Ontario Power Company plants at the Niagara cataract, and he followed this with the construction of the costly but magnificent Chippawa-Queenston Development.

There were in fact a number of purchases of power plants carried out under the Chairmanship of Sir Adam Beck, including the taking over of the generating plants and distribution systems of the Trent Valley district and the subsequent construction of further generating plants on the Trent River. There is no need to labour this point. The whole Georgian Bay System buys not one h.p. per year from private sources, and it is safe to say that had Sir Adam lived, neither the Eastern nor the Niagara Systems would have to-day been paying tribute to private owners of the sources of power.

### Power Shortage Was Anticipated in 1923

Now there is no debate about the fact that in 1923, a power shortage was anticipated. Sir Adam Beck spoke of an impending power shortage in an address to the Ontario Municipal Electric Association on November 14th, 1923. He was constantly discussing it, and what is interesting now to note, are the steps by which he proposed to meet the increasing peak demand. This is important in order that we may correctly appraise the actions of those who took control after his death, and the bearing which these facts now have on our present problem.

### Steam Plants for Peak Load Recommended

In the address to which I have referred Sir Adam stated as an item of good news, that the Government, he thought, would not refuse authority to proceed with the installation of a large steam plant in the city of Toronto, of a capacity not less than 100,000 h.p., and perhaps eventually 300,000 h.p. Sir Adam said, "Undoubtedly steam plants will be a great help to us working at 40 per cent. of 1,000,000 h.p., because when we get the full development at Niagara we shall have close to 1,000,000 h.p. within the next two or three years. This means an additional 400,000 h.p. of electrical energy and the fact of the matter is that we will not have to build any more transmission lines for many years to come."

Sir Adam followed this statement with an item in THE BULLETIN, published in January, 1924, by the Commission, in which he says, "The construction of auxiliary steam plants is the only alternative which appears to furnish an immediate and sure method of meeting the impending power crisis at the present time."

Perhaps some of my listeners are wondering why at that particular time a steam plant could be more economical than a water-power development. For continuous power, steam is, of course, more costly than water, but the entire demand on the Niagara System is not continuous, but rather rises to great heights at certain hours of the day and particularly in certain months of the year. The problem was to meet this peak demand which might be for but a few minutes in the day or for a few hours on certain days in the entire year. The point is, that a comparatively inexpensive steam plant can stand idle at less cost per h.p. than can a costly hydraulic development with a long and expensive transmission line.

### Beck's Steam Policy

Sir Adam's policy was to develop power on the Niagara, the St. Lawrence and the Ottawa Rivers to meet the demand for continuous power and to take care of intermittent peak demands by the construction of steam plants. According to data prepared at that time and still on the files of the Commission, the engineers calculated the cost of power for 5 per cent. of the year at $12 per h.p. when generated by steam as against $23.00 per h.p. when transmitted from Ottawa River plants. The engineers estimated that the call on the steam plant would not exceed 5 per cent. in the first year in which the System's peak should exceed the hydraulic capacity which the Niagara System then possessed. The engineers reported that the steam plant would have to run 35 per cent. of the time before the cost of steam would equal that of power from the Ottawa River.

The Opposition in the Legislature have been alleging that Sir Adam Beck was not in favour of steam but that he chose Quebec power for the Niagara System. They must take this position to avoid having to admit

that Beck's policy was discarded by Ferguson, Magrath and Maguire immediately after his death, and that that change is responsible for the present serious state of Hydro.

In this connection much has been made of a letter from the Secretary of the Hydro-Electric Power Commission to Mr. G. Gordon Gale, Manager of the Hull Electric Company under date of the 10th of December, 1924, intimating that the Commission would be prepared to pay $15.00 per h.p. for power so soon as the demand warranted the construction of a high tension transmission line. This letter had reference only to the Eastern district; it had nothing to do with the problems of the Niagara district.

The written records in the files of the Commission speak with more authority than do members of the Opposition on what was Beck's policy. It is clear beyond peradventure that Beck's policy for the Niagara System was one, two, or even three steam plants, each of a capacity of 100,000 h.p.

### Actions are Conclusive

Let the following facts speak for themselves.

On the 20th of November, 1924, Mr. Gaby reported to Sir Adam the necessity of a 100,000 h.p. steam plant by 1927.

On the 2nd of December, 1924, Sir Adam wrote to Premier Ferguson making application for authority to proceed with the construction of a steam plant.

The next month, that is to say in January, 1925, Sir Adam created a steam department under an engineer specially trained in this subject.

Early in the same year, the Ontario Legislature appropriated $5,000,000 for the construction of a steam plant and electrical generators of an initial capacity of 100,000 h.p.

On the 28th of May, 1925, the Hon. J. R. Cooke, then a Hydro Commissioner and Minister without Portfolio in the Ferguson Government forwarded a memorandum to the Prime Minister in favour of the immediate construction of a steam plant.

In June, Mr. Gaby, the Chief Engineer, forwarded a memorandum to Mr. G. T. Clarkson who had been engaged by the Government to report on the steam proposal. Mr. Gaby was in favour of proceeding with steam construction and he set forth the necessity for the plant and the economies which might be expected.

Mr. Clarkson reported to the Premier on the 17th of July, 1925. His report was voluminous and detailed, and it advocated the construction of steam plants of a capacity up to 300,000 h.p.

This was Beck's policy, and who now can deny it. It was a policy which would have saved Hydro millions of dollars.

### The Policy Changed on Beck's Death

Sir Adam Beck died in the month following Clarkson's report, namely on the 15th of August, 1925. The picture changed. The guardian had departed. Messrs. Magrath and Maguire joined Mr. Cooke as Hydro Commissioners and the whole System passed into political control. The steam department was closed, and with positively indecent haste, before eight months had gone by, the Beck policies were abandoned and the System was tied to the purchase from the Gatineau Power Company of 260,000 h.p. of electrical energy, the first of a series of disastrous power purchases which have well-nigh wrecked the Niagara System.

Why this unseemly haste, unless it was that 1926 was an election year?

Mr. Magrath was made Chairman on the 12th of September, 1925, and by the 25th of the following month we find him wiring to G. Gordon Gale of the Hull Electric Company: "We are in agreement and wish to go into the whole question with you at your convenience."

It had taken Mr. Magrath just 44 days to abandon the well-considered policy of Sir Adam Beck, of the Hon. J. R. Cooke, of Chief Engineer Gaby, and of special-advisor Clarkson and to adopt a new policy, the momentous consequences of which are now appallingly apparent.

### Opinions Within Hydro Were Contrary to New Policy

It is interesting to note that engineering opinion within the Hydro did not change with varying political control. On the 22nd of February, 1926, Mr. Brandon, the Chief Electrical Engineer forwarded a memorandum to the Chairman pointing out that the transmission line to convey power from the Ottawa River would cost the sum of $16,000,000 and would involve a loss of power by leakage of 25,000 h.p. per annum, and he added a schedule of

comparative costs as between Ottawa-Quebec power and steam generation. It showed Quebec power as costing $23.00 irrespective of the number of hours per day or the number of days in the year in which it might be used, and it showed steam as costing $12.00 if producing power for 5 per cent. of the time, $20.50 if producing power for 25 per cent. of the time, and $23.50 if producing power for 35 per cent. of the time.

Mr. T. H. Hogg, the Chief Hydraulic Engineer of the System, came forward with a memorandum on the advantages of what he called the Queenston Forebay System. By collecting the water of the Chippawa Canal during periods of low demand and storing it for use during hours of heavy demand, a further 170,000 h.p. for peak purposes, could, he said, be obtained at an expenditure of only $11,000,000.

On the 3rd of April, Mr. Brandon informed Mr. Gaby that a contemplated purchase of 260,000 h.p. at $15.00 per h.p. for a period of thirty years had a present worth of $60,000,000 with money at 4½ per cent.

On the 13th of April, 1926, Don Carlos, the Chief Operating Engineer submitted a memorandum to the Chief Engineer in which he expressed the opinion that the Commission's present equipment was able to supply the peak requirements of the coming winter, and added that the cheapest way to provide against peak shortage would be to compensate some of the larger power users for shutting down during the peak hours of the peak months.

### First Quebec Contracts Signed

But apparently the new policy had already been set. The die was cast with the death of Beck and the appointment by Premier Ferguson and his Cabinet associates of Messrs. Magrath and Maguire in place of the great figure who had dominated Hydro for 20 years. How different was the new point of view is seen from what followed.

On the 1st of April, 1926, Mr. Graustein sent for acceptance *that day* an offer for the sale of 260,000 h.p. delivered at the interprovincial boundary at $15.00 per h.p. or $3 900,000 per year. That day! Why such haste? This was an offer involving payments by the Hydro of more than $100,000,000. It was to bind the Commission over a period of thirty years, and yet it is couched in the phraseology of a broker in fruit or eggs. It was for acceptance the same day. And it was accepted the same day, namely, on the 1st of April, 1926, the most outrageous April fool's joke ever perpetrated on the people of Ontario.

What is the explanation of this reversal of Beck's policy? If any of my listeners have a key to the riddle, I wish they would send it to me.

### Servants of the Power Users

This series of broadcasts is for the purpose of laying the facts of the Hydro situation before the people of this Province; and for the purpose of asking for your thought, and your advice. On behalf of myself, of the Prime Minister and of the Government, I am asking seriously for your co-operation in this matter. I want you to write me at the Parliament Buildings and I promise you that every letter which I receive will be read and acknowledged.

Speaking in the Legislature as the leader of the Opposition, the Hon. Mr. Henry ridiculed an appeal to public opinion. He says that he considers a discussion of this public question by a member of the Government in this public way an affront to the Legislature. It seemed to me to be significant that one who is himself responsible, as a former member of the Ferguson Cabinet, for the fall of Hydro into the present morass, should object to any consultation with those who must pay the bill.

For my part I look upon the Hydro Commission and the Government of Ontario as servants of the power users and of the tax-payers of Ontario, and Premier Hepburn and his associates are sufficiently democratic actually to desire your opinion and advice. Please let me hear from you.

Tomorrow evening I propose to deal further with the Hydro crisis, and particularly with the secret and other agreements by which the power users of the Province of Ontario were sold out to the Province of Quebec.

* * * *

## PART THREE

### AMAZING DETAILS OF IMPROVIDENT CONTRACTS WITH QUEBEC COMPANIES

Ladies and gentlemen of the radio audience. In my last evening's broadcast, I told you of the unseemly haste with which Prime Minister Ferguson and his appointees on the Commission abandoned the policy of Sir Adam Beck and plunged precipitately into a $100,000,000 contract with the Gatineau Power Company. Sir Adam was not forty-four days cold in a grave which Canadians honour as that of a great man when is successor Magrath wired to the Manager of a Quebec Company that he and they were in agreement on a course of action which reversed the well-considered plans of Hydro's former Protector, which has increased power rates by 50 per cent. or $10.00 per h.p. in five years time, and which has left the Hydro System staggering under huge annual deficits and with a future which no one can definitely forecast.

Tonight, I propose to tell you something of the astonishing details of the Gatineau transaction and the even more amazing betrayals which followed.

As I told you last night, the Ontario Hydro under Sir Adam Beck had thoroughly considered the alternative plans for supplying power during the short rush periods in the dark afternoons of November and December when demands for light and power reach unusual dimensions. There were many alternatives. The Niagara River held a further potential 1,000,000 h.p. The St. Lawrence was untouched. The Carillon, Chats Falls, and DesJoachin, all great powers on the Ottawa River, were undeveloped. There remained also a number of smaller potential developments on the Madawaska, the Mississippi, the Moon, the Muskosh, the Spanish, and the Mississagi Rivers, and there was the 200,000 h.p. peak proposition at Decew Falls, near St. Catharines.

For various reasons these alternatives were rejected in favour of a policy of supplying peak or momentary demands by inexpensive steam generation. This was a policy concurred in by the entire Hydro executive, including the Chairman, Sir Adam Beck, Commissioner Cooke, Chief Engineer Gaby, and Mr. G. T. Clarkson, the Government special advisor. It was demonstrably sound for periods of rising business activity. In periods of falling activity it would put Hydro in an impregnable position. Engineers now calculate that it would have saved Hydro approximately $20,000,000 to date, over the course actually adopted.

Now observe that in abandoning this sound and proper policy the new Hydro management entered into the 260,000 h.p. Gatineau contract without any recommendation from the staff engineers of the Hydro system; without any explanation of the existing memoranda by Beck, Cooke, Gaby, Clarkson and others in favour of steam; and without consultation with the municipalities affected.

#### THE GATINEAU AGREEMENTS

The statutes provide that before the Hydro can complete an agreement such as that with Gatineau it must be recommended by the Hydro Commission and approved by Order-in-Council. Neither of these prerequisites existed when, on the 15th of April, 1926, the then Premier, Mr. G. Howard Ferguson, announced to the Press a contract with the Gatineau Power Company for 260,000 h.p. delivered at the inter-provincial boundary, at a cost of $15.00 per h.p. This agreement he described as a "splendid achievement". Just how splendid we are now in a position to judge.

Following Mr. Ferguson's announcement the Chief Engineer, Mr. Gaby, proceeded to swallow himself in a memorandum in which he approved the contract, but in which significantly enough he made no attempt to explain his previous memoranda; or to compare the relative advantages of the plans.

#### THE SECRET AGREEMENTS

And now I come to perhaps the most amazing feature of this amazing transaction. The contract was broken up into five separate agreements. There was a main agreement, containing the standard clauses covering payments to be made, details of operation and so forth, which must necessarily become public; and then there were four supplementary agreements which were intended to be, and actually have been, kept secret during the nine years which have elapsed, until at the

present sitting of the Legislature I exposed them in the House.

In the Minutes of the Hydro-Electric Power Commission of the 3rd of May, 1926, (present, Magrath, Cooke and Maguire) there appears the following significant sentence: "It was decided to embody some provisions in supplementary agreements for reasons that are obvious." Next day Chairman Magrath wrote to Premier Ferguson forwarding executed copies of the main agreement and of the four supplementary agreements and in his letter he recommended that the main agreement be approved by one Order-in-Council, and the supplementary agreements by another Order-in-Council.

Why two Orders-in-Council dealing with one matter? The reasons are obvious. The separate Orders-in-Council were to make possible the keeping secret of the outrageous terms of the supplementary agreements and to facilitate the deception of the Hydro municipalities, the power users, and the people of Ontario.

### Commission to Pay if Power Kept Available

The terms of the main agreement were bad enough. Two of these terms may be mentioned. Firstly, the agreement provides that the Commission was to pay for power if "kept available" by the Company. That is to say, the power was to be paid for whether or not the Commission, or the municipalities, were able to use it. The public were to take all the chances of business and financial depression, wars and rumours of wars, and were to pay $3,900,000 per annum, year in and year out, for thirty years. This is the direct opposite of the forms of contract used when Hydro was started.

Secondly, the agreement was for a term of thirty years. It therefore contemplated the establishment of an industrial population growing up in dependence on this source of power, and yet the agreement made no provision for renewal at the end of the term. This was a shocking disregard by those in authority of their duty to protect the public. It stands in striking contrast to what takes place under public ownership when at the end of such a term of years, the sinking fund has paid off the indebtedness and the plant is owned by the people free of encumbrances.

The terms of the main agreement were made public; and were bitterly resented by the friends of the Hydro movement. They were attacked by public men on the platform and in the press. But what would have been said had the disappointed advocates of public ownership known of the outrageous betrayal of the power-users of this Province which were evidenced by the terms of the supplementary agreements?

### Quebec Can Cancel at Will

The first of these long secreted and mysterious documents read as follows: "The Company shall not be liable for any partial or total failure to deliver electrical power or energy under the principal agreement, which is due to the act of the Province of Quebec."

That is to say, the agreement to deliver power might be terminated at any time without liability on the part of the Company by an act of some person in authority in the Province of Quebec. The Commission was to build transmission lines and transformer stations at a cost of $16,000,000 for a supply of energy which might at any moment be cut off. The Province of Ontario was to build up an industrial population which, with or without connivance on the part of the Company, might be left destitute of power by some simple act of the Legislature, of the Executive Council, or of some Minister or official of the Province of Quebec. The Ontario Hydro was to be bound for thirty years and the Gatineau Company was to deliver at will.

Should a power shortage arise at any time within the thirty-year term, the Province of Quebec is in a position with the express consent of the Hydro Commission and the Government of Ontario to cancel the contract without any liability on the part of the Quebec Company, and the industries of Ontario can go hang.

### Quebec Can Tax Ontario People

The second supplementary agreement is, from one point of view, more outrageous than the first, for it provides that should the Gatineau Company be subject to any provincial taxes or charges not then in existence or should any existing taxes or charges be increased, then a corresponding increase should be made in the price to be paid for the power. A recently authorized Quebec tax not then promulgated was to be

considered as not then in existence, so that if promulgated its burden would fall on the power-users of Ontario. Can one imagine a more abject surrender of its people by one Parliament to taxation by another Parliament—a direct negation of the principle of no taxation without representation.

And so the Ontario Hydro-Electric Power Commission, with the approval of the Ontario Government of that time, bound the power-users in this Province in the chains of agreements which were thought to be binding. It delivered its own people in bondage to the Province of Quebec; and it surrendered the industrial institutions of this Province to the merciful forbearance of the Legislature of Quebec.

In my judgment no more abject or disgraceful betrayal of one's own people by a governing authority has taken place since Charles Stuart accepted subsidies from the King of France.

### The Gatineau Company Properties and Financing

The nigger-in-the-woodpile of the third agreement is not so readily discernible. To understand its significance, I must digress for a moment into another, though allied subject.

In all the literature of high finance there is little that equals and nothing which excels the golden glamour of the Gatineau. That picturesque river is a tributary of the Ottawa through which a considerable portion of the water from Northern Quebec finds its way to the St. Lawrence River. On the Gatineau River there are three power sites. That nearest the Ottawa River is called Farmers, the next is Chelsea, and that highest up is known as Paugan.

In 1919, Farmers and Chelsea were owned by a company of lumber operators of Ottawa, named Gilmour & Hughson Ltd., and were carried on the books of that Company at a value of $18,915.93. The two powers were sold by this company, together with other assets, for no apparent increase over that amount, to the Canadian International Paper Company, Mr. Isaac Walton Killam, of the *Mail & Empire*, appearing as an interested party in the transaction. The International Paper Company then acquired certain lands and riparian rights on the Gatineau River necessary to the development of these two power sites at an expenditure of $39,596. The point I am making is that in 1919 these two power sites, together with the lands and rights necessary for their use were valued at $58,511.93.

### The Paugan Power Site

Bearing this figure in mind for the moment, let me turn to the third power—that called the Paugan. It was acquired some time between 1917 and 1926 by the Hull Electric Company, a completely-owned subsidiary of the Canadian Pacific Railway, for the sum of $409,279.34. At the time when these main and supplementary agreements were being negotiated, Farmers and Chelsea were thus owned by the International Paper Company, and Paugan by the C.P.R. Mr. Graustein was President of the Canadian International Paper Company, and also of the Gatineau Power Company.

And now for some real financing. The fourth supplementary agreement provided that Mr. Graustein might cancel the Gatineau agreement should he fail to consummate the purchase of Paugan. In other words, the financier, Mr. Graustein, was sent forth with the Province of Ontario under option in his pocket, to negotiate a purchase from the C.P.R. Of the battle of the giants which followed, little is known, beyond the fact that when the smoke cleared away the International Paper Company had paid to the C.P.R. for a power site which cost that Company $400,000, the sum of $4,000,000.

But what is $4,000,000 among friends? The next act in the drama is the sale of the three power properties by Mr. Graustein as President of the International Paper Company to Mr. Graustein as President of the newly incorporated Gatineau Power Company.

The price which the Gatineau Power Company paid, on the strength of its contract with the people of Ontario, represented by Messrs. Ferguson, Magrath, Gaby and Maguire, was the following: $17,000,000 in cash, and the balance of the purchase in 6 per cent. debentures and common stock of the Gatineau Power Company to a total of $41,000,000.

### Fabulous Prizes for Financiers

As I stated recently in the Legislature, Pizarro's Spanish freebooters found nothing so fabulous as this in the temples of the

Incas—the English buccanneers who singed the beard of the Spanish King never brought home a prize which equalled in splendour the gift which Messrs. Ferguson, Henry, Price and Magrath presented to the financiers of St. James Street.

Just how valuable was the contract may be learned from the lips of the Company's own brokers. The agreement went into effect. The Gatineau Power Company proceeded to sell $25,000,000 of first mortgage gold bonds, and the company's brokers issued a circular in which there appeared the following significant statement: "The thirty-year contract with the Hydro-Electric Power Commission will alone produce annual net earnings for interest and reserves over 1.8 times such interest charges."

It is interesting to note that the Company now has outstanding first mortgage gold bonds of $69,928,500 in a total capitalization issued and outstanding of some $115,000,000 upon which the power-users of the Province of Ontario are expected to do their part to pay dividends, for the next quarter of a century.

But this is not the whole story. One can fancy the consternation with which Mr. Graustein must have received that advice of his solicitor that this golden agreement for the delivery of power at the inter-provincial boundary was unenforceable at law. The files of the Hydro Commission record the haste with which that body sprang to his rescue. A fifth supplementary agreement was drawn, executed and validated by Order-in-Council, changing the place of delivery of power to a point in Ontario, ten feet distant from the inter-provincial boundary. This document was then forwarded to the President of the Gatineau Power Company, no doubt with a devout hope that every legal shackle on the power-users of Ontario had been duly forged and tempered.

### Anticipated Power Shortage Did Not Materialize

In appraising the enormity of the Gatineau transaction we must bear in mind that there was no excuse for the abandonment of the principle of public ownership; and that the turning aside from steam and other alternatives has never been explained.

A power shortage had at that time actually been anticipated; but the expected shortage did not occur. By November, 1929, the peak demand for firm power was still below the 850,000 h.p. at which Mr. Gaby had in 1926 estimated the capacity of our Niagara River resources. In the interval between 1926 and 1929 practically all the 260,000 h.p. from the Gatineau was in excess of the system's requirements. Not only so, but in June, 1929, there appeared in the sales returns of the Hydro Commission a slowing up of such increase in power sales as had previously taken place. There was a general slackening of industrial activity and a falling in commodity prices. The industrial storm signals were out, and in October, 1929, there occurred the market crash which announced with dramatic emphasis the end of a period of expansion.

### The Beauharnois Contract

What then will you say when I tell you that in the face of these obvious warnings, and notwithstanding the fact that the full 260,000 h.p. from Gatineau was still in excess of the System's firm requirements, Messrs. Ferguson, Magrath and Gaby actually entered into a further contract on the 29th of November, 1929, with the Beauharnois Light, Heat and Power Company for an additional 250,000 h.p. for forty years at $15.00 per h.p., or $3,750,000 per h.p. per year. This was done in full realization of the fact that the delivery of Beauharnois power in Toronto would necessitate the construction of an additional transmission line along the North Shore of Lake Ontario for a distance of approximately 250 miles at an estimated cost of $18,000,000 and with a loss in power by leakage of 30,000 h.p. per annum at a cost of $450,000 per annum on this item alone. That line has never been built.

Shocking as was the Gatineau contract, it is put into the shade by the utter disregard of common sense or public decency observable in this and subsequent power purchase contracts.

Tomorrow night I shall describe in some detail the transactions with the Beauharnois, Light, Heat and Power Company, with the James Maclaren Company of Quebec, and finally with the Ottawa Valley Power Company, by which block after block of unneeded power was heaped on the shoulders of the Ontario power-users, until Hydro was left staggering under the

financial weight of the combined commitments.

Tomorrow's address will conclude this series; and we must soon come to grips with the serious problem of Hydro's future. Before closing please permit me to remind you that I am stating these facts for your information so that you may be in a position to form your own judgment of the matters in issue, and so that you may, if you will, give the Government now in office the benefit of your advice.

* * * *

## PART FOUR

### Quebec Agreements are Void, Illegal, and Unenforceable

Ladies and gentlemen of the radio audience. In the course of my three previous broadcasts, I have told you of the financial difficulties which confront the Niagara System as a portion of the Hydro-Electric Power enterprise of Ontario, of the rapidly-rising cost of electrical energy, and of the huge deficits of the last three successive years due to the expenditure of fabulous amounts for unwanted power, and, as a natural consequence, of the rapidly-diminishing reserves. Last night I gave you in outline the story of the Gatineau purchase, which included the abandonment of public ownership as applied to the sources of power and the generation of electrical energy, the reversal of the Beck policies, and the tie-up to a payment of $3,900,000 a year whether the power represented could or could not be used.

In the short half-hour at my disposal this evening, I shall relate the facts of the three subsequent Quebec purchases which, when the individual commitments are totalled, assume to obligate the Hydro-Electric Power Commission to payment for 731,000 h.p. whether used or unused, at an annual charge, when deliveries are complete, of $10,965,000 per year.

### Doubtful Auspices of Beauharnois Agreement

The first intimation in the records of the Hydro-Electric Power Commission that a contract was in contemplation between the Beauharnois Light, Heat and Power Company and the Commission is contained in a letter from Mr. R. O. Sweezey to Mr. Gaby of the 2nd of May, 1929, in which he says that a tentative agreement has already been reached. It is curious to note that up to this point no reference appears in the minutes of the Commission of any proposal to purchase power from Beauharnois, nor is there any information in the files of the Commission to indicate that a study had been made of the details of such a proposal, other than an estimate by Mr. Brandon of the cost of a transmission line. Significantly enough, there appears some eighteen days afterwards, a memorandum by Mr. Gaby attached to the minutes of the 20th of May, 1929, in support of the proposal, but that portion of the memo which refers to Beauharnois is said to have been added at a later date, and it was referred to in the Ontario Legislature by my fellow-Commissioner Mr. McQuesten, as the "phony minute." As opposed to Mr. Gaby's memorandum, the minutes of the Commission of that date state that all the engineers were strongly of the opinion that the Commission should acquire the O'Brien properties on the Madawaska and Bonnechere Rivers, the Dominion Power and Transmission Company's properties, as well as those of the Canadian Niagara Power Company, on the broad grounds of sound Provincial policy. It is to be noted that the engineers were unanimously for public ownership and that no reference is made in these minutes to a purchase from Beauharnois.

These are the doubtful auspices under which this contract was entered into. There was a letter by Mr. Magrath dated the 27th of May, 1929, setting out the terms. The election took place on the 30th day of October, 1929. Then followed the market slump and the formal contract was completed on the 29th of November, 1929, in which the Commission, with the approval of the Ferguson Government, obligated itself to pay for 250,000 h.p., whether used or unused, at $15.00 per h.p. for 40 years by monthly payments of $312,500, that is to say, in excess of $10,000 a day, or something more than $400 an hour.

It may not be out of place to mention at this time that the contract was negotiated

on behalf of the Company by Mr. R. O. Sweezey and that a sinister aspect is given to the whole proceedings by his admission that he paid to John Aird, Jr., $125,000 as a subscription to the campaign fund of the Ontario Conservative Party.

### Ottawa Valley Power Company Agreement

One would have thought that these commitments for 510,000 h.p. at over $7,500,000 per year would have satisfied even the most reckless adventurer. But Mr. Isaac Walton Killam whom we have noted in connection with the sale of Farmers and Chelsea powers on the Gatineau River, was also holder of the dominant interest in the Ottawa Valley Power Company, which owned the Quebec side of the Chats Falls power on the Ottawa River. Mr. Killam had purchased the Mail and Empire newspaper of Toronto on the 3rd of October, 1927, and had supported through the election of 1929 the earlier power purchase contracts, as he is doing now.

However that may be, we find that notwithstanding the then prevalent depression, the Hydro-Electric Power Commission on the 15th of February, 1930, entered into an agreement with the Ottawa Valley Power Company for a development at Chats Falls, by the construction of a dam four miles in length, and the building of a plant directly across the inter-provincial boundary which traverses the centre of the river. The Hydro Commission furnished the engineers, together with all its experience and data at cost, and the plant was built, and one half presented to Mr. Killam on a basis of actual outlay. The agreement provided that the plant was to operate under a joint board and that the Commission was to purchase from Mr. Killam's company 96,000 h.p. at $15.00 per h.p. for forty years. This represented payments totalling $57,000,000. On the strength of this agreement, the Ottawa Valley Power Company disposed of $9,000,000 of bonds; and once again we learn from the lips of the Company's brokers how rich a haul had been made at the expense of Ontario's power-users. It was estimated that the proceeds of the contract with the Hydro-Electric Commission of Ontario would furnish more than twice the interest requirements of the first mortgage bonds, whose face value was $1,000,000 more than the cost of development.

### Comparative Costs of Power at Chats Falls

The Chats Falls Plant has been in operation for approximately two years. It furnishes a striking comparison as between the cost of public generation and of purchased power. Each side of the plant has a capacity of a full 96,000 h.p. at peak, and, on the basis of this output, with the expense of operation and with all regular reserves and interest on investment included, the cost of generation in the Commission's own plant is $6.86 per h.p. For the purchased power, delivered at the very same point we are paying the private company $15.00 per h.p. per annum.

I have it on the authority of the Chief Municipal Engineer of the Hydro System, that the 96,000 h.p. developed on the Commission's side of the Chats Falls plant could be transmitted to Toronto on a specially-built line for delivery at Leaside for $12.95 per h.p., a figure which stands in striking relief against the present cost of Hydro delivered at Toronto.

### The Maclaren Company Agreement

And now we come to the last, and what Mr. McQuesten has termed the "most impudent" of all these power contracts. With more than 600,000 h.p. already overbought, in the face of a depression which had steadily increased in severity for the previous fourteen months, with business stagnation and decreasing power sales, on the record, the Commission and the Government had the audacity to enter into a further purchase of 125,000 h.p. at $15.00 per h.p. or $1,875,000 per year for a period of forty years, this sum to be paid annually whether the power could or could not be used. The explanation for this audacious and shocking transaction is that prior to the election, at the solicitation of Mr. R. O. Sweezey, the Chairman of the Commission had exchanged letters purporting to commit the Commission, and to pledge the power-users of Ontario in an illegal and unenforceable manner to the Maclaren Company. The execution of the formal contract represented the implementing of this improper pre-election agreement.

Such are the facts. In this statement I have said nothing of the purchase from the Gatineau of power for the Eastern district, followed by the Madawaska purchase in

connection with which John Aird, Jr., was paid $50,000. Nor have I said anything of the sordid story of the Abitibi Canyon. These matters are not pertinent to a consideration of the present problems arising out of the apparent commitments of the Hydro-Electric Power Commission for hundreds of millions of dollars for unwanted power.

I have told you the story as it is pertinent to the enquiry; the question now remains as to what we shall do.

### All Illegal, Unenforceable and Void

Perhaps I may assist you in coming to a conclusion as to what should be done in this connection, when I tell you that in my view these contracts with the four companies, namely, Gatineau, Beauharnois, Ottawa Valley and Maclaren are all illegal, unenforceable and void from their very inception. This is so because they expressly contemplate and necessarily require the construction by the contracting parties of works and undertakings which connect one province with another province, or which extend beyond the limits of a province, this being a field of legislative jurisdiction which is reserved by the British North America Act to the exclusive authority of the Dominion Parliament. A private corporation brought into being by a Provincial Legislature, cannot do those things of which its creator is incapable of performing. All four companies with whom the Commission is now under contract are incorporations of the Legislature of the Province of Quebec, and they have contracted to deliver power at the inter-provincial boundary by works connecting the Province of Quebec with the Province of Ontario, or at some point within the Province of Ontario.

In support of this definite conclusion, I have considered opinion of Mr. Lewis Duncan, K.C., in my judgment one of the ablest constitutional lawyers in the Province of Ontario; and since I stated this proposition in the Legislature no effective reply of any kind has been made by the solicitors of the power companies or by the defenders of the power barons who sit in the seats of the Opposition in the Legislature at Queen's Park in Toronto.

One prominent lawyer, representing the Beauharnois Company, has stated that the purchase of h.p. is similar to the buying of bottles of milk. As some persons say, "It is to laugh." The British North America Act makes special reference to works connecting the provinces or extending beyond the limits of a province but that Act makes no mention, so far as I have been able to discover, of the sale or purchase of bottles of milk.

Nor, indeed, is any effective reply possible. For the legal principle involved has been decided in a number of important cases in the Supreme Court of Canada and by the Judicial Committee of the Privy Council, the highest court of appeal in the British Empire.

It is not therefore a question of Hydro repudiating its contractual obligations. The real issue is that the power companies and their friends in the Opposition at Queen's Park wish us to compel the municipalities to continue to make enormous payments for unwanted power on the strength of imaginary obligations. It is my view that the Quebec power companies have no right to the continuance of these payments either in morals or in law.

Moreover, a Hydro Commission, with no capital of its own, cannot do more than justice to one without doing less than justice to another.

### Hydro Municipal Agreements Specify Power from Niagara Falls or Vicinity

The Hydro-Electric Power Commission is under contract with some three hundred municipalities to supply them with power from Niagara Falls or the vicinity of the Niagara River, such power to be supplied at cost as defined in the contracts themselves, and in the Power Commission Act. These Agreements do not contemplate that the Commission supply Quebec power in addition to or in place of the Niagara power for which the municipalities contracted; and no authority is given by statute to the Commission to enable it to force upon the municipalities electrical energy for which they have not contracted. Much less is there authority to charge the municipalities for power which they have not ordered, which they cannot use, and which in fact has not been delivered.

### Municipal Agreements are Validated

Now the power companies and their well-paid legal advisers must have known, or be deemed to have known, the limitations set by law upon the powers of the Hydro-Electric Power Commission and

the Executive Council of Ontario, for these limitations are set out in the public statutes. Approval by the Lieutenant-Governor-in-Council cannot, of course, over-ride an Act of Parliament or make lawful that which is by statute unlawful.

Now please observe that every one of the agreements with the three hundred odd municipalities comprising the Niagara System was validated by Act of the Ontario Legislature, long before the Quebec power purchases were in contemplation, and that these supposed power purchase contracts have never been validated by the Ontario Legislature. And why? Because, forsooth, to have validated the company contracts would have necessitated the repeal of acts in validation of the municipal contracts. The authors of these iniquitous transactions shrank from submitting them to Parliament. They dared not risk the exposures which such a course would have involved.

The problem therefore that confronts us is not a case of competing equities. It is rather whether or not we should in effect repudiate the three hundred contracts with the municipalities, binding as they are in law and in equity and validated by acts of Parliament, in order that we may give effect to the terms of illegal arrangements with four private corporations—arrangements which are not contracts at all, which have never been validated by Parliament, and which are without support either in law or in equity or in morals.

### No Governmental Guarantee

It is of course true that the very clever promoters of these companies have sold bonds and securities of the companies to an unsuspecting public; but the promises contained in these bonds and securities were never guaranteed by Governmental authority; and the ability of the companies to pay interest and dividends rests upon legal rights as they actually exist rather than as they may have been represented or as the purchasers might now wish them to be. The rights of the purchasers against the promoters is not for me to determine, but such loss as they may have sustained cannot in justice be levied by the Hydro Commission upon the innocent power-users and the municipalities.

Let me most emphatically point out that there is no similarity between the bonds of these four power companies and those of the Hydro-Electric Power Commission or of the Government of Ontario. Government and Hydro bonds were issued for value received and stand upon an altogether different footing.

### Rising Costs to Municipalities

There is nothing to gain by closing our eyes to the fact that the continuance of the colossal payments set out in these contracts will entail recurring deficits in large figures and rising costs of power.

Before these contracts were entered into we were charging Toronto $24.00 per h.p. for power. Last year we charged $26.13 per h.p. and it cost the Commission $30.85 per h.p. If these contracts were binding and if there were neither increase in revenue nor decrease in the expense of operation of the Commission, the cost of power in Toronto by 1938 would increase to approximately $39.00 per h.p.

You business men and workmen of Hamilton observe; your City paid $24.00 per h.p. before the rigging of Hydro commenced; last year you paid $25.12 per h.p. and it cost Hydro $29.84 for every h.p. which you used. By 1938, on the basis of calculation I have mentioned, your City will pay $38.00 per h.p.

What about you people of London? You paid $25.00 in 1925, and last year you paid approximately $26.81 and it cost $31.53 for each h.p. that was consumed. By 1938 on the above basis of calculation the cost would be $39.00 per h.p. Do you accept that prospect?

Or again, you people of St. Thomas. Your local Commission paid $28.38 last year and it cost $33.10. Are you ready to risk a charge of $40.00 per h.p.? And so on throughout the municipalities of Ontario. What about you people in the smaller towns in the out-lying districts, now paying rates of approximately $40.00 per h.p.? What would you say to power charges of $46.50 per h.p.?

What do the patriotic citizens of this province generally think of this matter. Do you think that we should allow the light-users, the industrialists, and the municipalities of this province to be sacrificed to the indentured beneficiaries of Mr. Ferguson's policy? What say the mayors and aldermen of the municipalities of Ontario who are struggling with almost impossible municipal problems? Are you satisfied that the resources of your tax-

payers shall be still further depleted by paying tribute in millions to these four corporations. What say you good citizens of Ontario—be you men or women, farmers or artisans? What say you thrifty housewives with your washing machines and your carpet sweepers, endeavouring to meet your monthly bills for light and power? What say you all? Are you satisfied to see the power and light-users of Ontario pay tribute in millions to the power gentry who obtained these agreements?

### A Democratic Government

I am the representative of a democratic government whose Prime Minister and his followers are appealing to the great court of public opinion for assistance in the discharge of an onerous public responsibility. This Government holds no brief for any single group and has the courage to act justly so soon as the proper course is made clear. This is the conclusion of my series of broadcasts. I thank you for having listened in such great numbers and so patiently to what I have had to say, and I look forward to hearing from you immediately. Your letter may be very short, for all that is required is your answer to the question: "Should the municipalities be required to continue to pay for unwanted power." They have already paid the companies some $28,258,458.69 on this account.

Do not delay, for this decision must not be much longer deferred. Thank you.

*An interruption occurred on the 46,000-volt steel tower line from Niagara Falls to Welland on the evening of Sunday, April 28th, 1935. It is supposed to have been caused by a bird trailing conductive material across the line in making a nest. This is borne out by the conductor burns and a small section of fine wire found at the scene of the trouble.*

*The accompanying illustration is of a crow's nest removed from one of the towers of this line. It is made of roots, twigs, string and pieces of wire. Some of the roots and twigs in the nest are remarkably large, in one direction, the branches extending 44 inches from the centre of the nest. The bits of string and pieces of wire are also of considerable length, which if they happened to be trailed in a certain manner, would undoubtedly interrupt service by shorting or grounding almost any type of transmission line.*

# The Power Commission Act, 1935

FOLLOWING the Honourable Mr. Roebuck's speech on Hydro in the Legislature and the subsequent debate, and directly after his radio appeal to the public, the Prime Minister, the Honourable M. F. Hepburn introduced the following Act in the Legislature; it was given its first reading on April 1st, and received its final reading on April 11th, 1935.

No. 89 1935

BILL

An Act to declare the law with respect to The Hydro-Electric Power Commission of Ontario and with respect to certain invalid contracts.

WHEREAS The Hydro-Electric Power Commission of Ontario was created a body corporate without capital to serve the interests of the people of Ontario and to supply such power or energy as the municipalities and the people of the said Province might require; and whereas it never was the intention of the Legislature of Ontario that the said Commission should have authority to impose financial and other obligations without consent upon the said municipal corporations, power users and taxpayers of the Province; and whereas in the year 1926 and subsequently The Hydro-Electric Power Commission of Ontario and certain corporations hereinafter more particularly referred to, did, without the consent of the said municipalities, or the ratepayers thereof, contrary to the rights of the said municipalities under existing contracts with the said Commission, and contrary to *The Power Commission Act*, and without regard to the provisions of *The British North America Act*, purport to obligate the said Commission by divers contracts to purchase over long periods of time large quantities of power generated without the Province of Ontario regardless of whether or not the said power was desired or could be used by the said municipalities; and whereas the said Commission has made payments of large sums of money under the said alleged contracts and has illegally charged the cost of the same against certain municipal corporations, and has thereby so increased the cost of power as to threaten industry within the Province and to cause unemployment; and whereas it is desirable to declare the law:

Now, therefore, His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. This Act may be cited as *The Power Commission Act, 1935*.

2. The said contracts, as hereinafter set forth, are hereby declared to be and always to have been illegal, void and unenforceable as against The Hydro-Electric Power Commission of Ontario, such contracts being as follows:

(*a*) Between the said Commission and Gatineau Power Company, five contracts bearing date the 19th day of May, 1926, and one contract bearing date the 27th day of July, 1926, set out in Schedule "A," hereto;*

(*b*) Between the said Commission and Gatineau Power Company, two contracts bearing date the 28th day of December, 1927, set out in Schedule "B" hereto;*

(*c*) Between the said Commission and Beauharnois Light, Heat and Power Company, one contract bearing date the 29th day of November, 1929, set out in Schedule "C" hereto;*

(*d*) Between the said Commission and Chats Falls Power Company, also known as Ottawa Valley Power Company, one contract dated the 15th day of February, 1930, and one contract dated the 24th day of February, 1931, known respectively as the "Power Contract" and the "Operating Contract," set out in Schedule "D" hereto;*

(*e*) Between the said Commission and James McLaren Company, Limited, one contract dated the 20th day of December, 1930, and one contract dated the 14th day of January, 1931, set out in Schedule "E" hereto.*

3. No action or other proceeding shall be brought, maintained or proceeded with against the said Commission founded upon any contract by this Act declared to be void and unenforceable, or arising out of the performance or non-performance of any of the terms of the said contracts.

4. The said Commission may from time to time pay for such power as it deems advisable, and may, with the approval of the Lieutenant-Governor in Council enter into contracts therefor, and may distribute the cost thereof and all proper charges incidental thereto as determined by it among such municipalities and in such proportions as it may deem equitable, and all distribution as to such costs and charges for power heretofore purchased are validated and confirmed.

5. The powers by this Act conferred on the said Commission shall be supplementary to the powers conferred on the said Commission by any other Statute.

6. This Act shall come into force on a day to be named by the Lieutenant-Governor by his Proclamation.

* Schedules "A", "B", "C", "D" and "E" appended to the Act are copies of the original agreements, which are not reproduced herein. —Editor.

# O.M.E.A. *and* A.M.E.U. Conventions

## *at* Bigwin Inn

## July 4, 5 *and* 6, 1935

# THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

## Rat Rapids Development

By J. R. Montague, Hydraulic Dept. and R. E. Hamilton, Electrical Engineering Dept., H.E.P.C. of Ont.

THE Hydro-Electric Power Commission of Ontario has recently placed in operation its Rat Rapids Development, located at the outlet of Lake St. Joseph on the Albany River, and supplying power to the Pickle Crow and Central Patricia gold mines. This area being located near the height of land, the heads available for power sites within reasonable transmission distance of the mining district are of relatively small magnitude. The head available at the Rat Rapids site is from 14 to 16 feet, which, with the installation provided, gives rated outputs of approximately 1,000 to 1,200 horsepower respectively at the low voltage bus.

The outflow from Lake St. Joseph is divided around a large island, the northerly outlet being known as the Rat Rapids channel and the southerly as the Cedars channel. Control dams were constructed across both outlets and the powerhouse is located at the northerly channel.

In view of the transportation difficulties, it was decided to construct the plant, as far as possible, from local materials. With this in mind, the dams are all built of rock-filled timber crib construction. The generating station superstructure is of log construction, chinked on the exterior face, between the logs, with oakum. The interior face is battened at intervals and lined with one-inch boarding over building paper. The roof is constructed of lumber sawn on the job, and covered with slate-surfaced rolled roofing. The turbine chamber roof is of similar construction, and where joined to the powerhouse roof an opening is provided to allow passage of warm air through the chamber as protection against freezing. The three operators' cottages are also of log construction, chinked between logs with oakum, and lined on the interior face with half-inch insulating board. A small building of similar construction was erected for the housing of radio equipment. The turbine chamber itself and the generating room substructure were constructed of concrete.

The obtaining of concrete aggregates

## CONTENTS

Vol. XXII No. 6
JUNE, 1935



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

was a rather difficult problem, it being necessary to transport the material across the eastern end of Lake St. Joseph a distance of from four to five miles in York boats towed by smaller boats propelled by outboard motors.

One factor which assisted materially in the progress of the work was the construction of marine railways, and a short section of standard gauge railway along the Root River connecting Lake St. Joseph with Lac Seul, permitting shipment by water from Hudson to the power site. Prior to this the only means of transportation was by aeroplane during both winter and summer seasons, and by overland route during the winter only.

### GENERATING UNIT

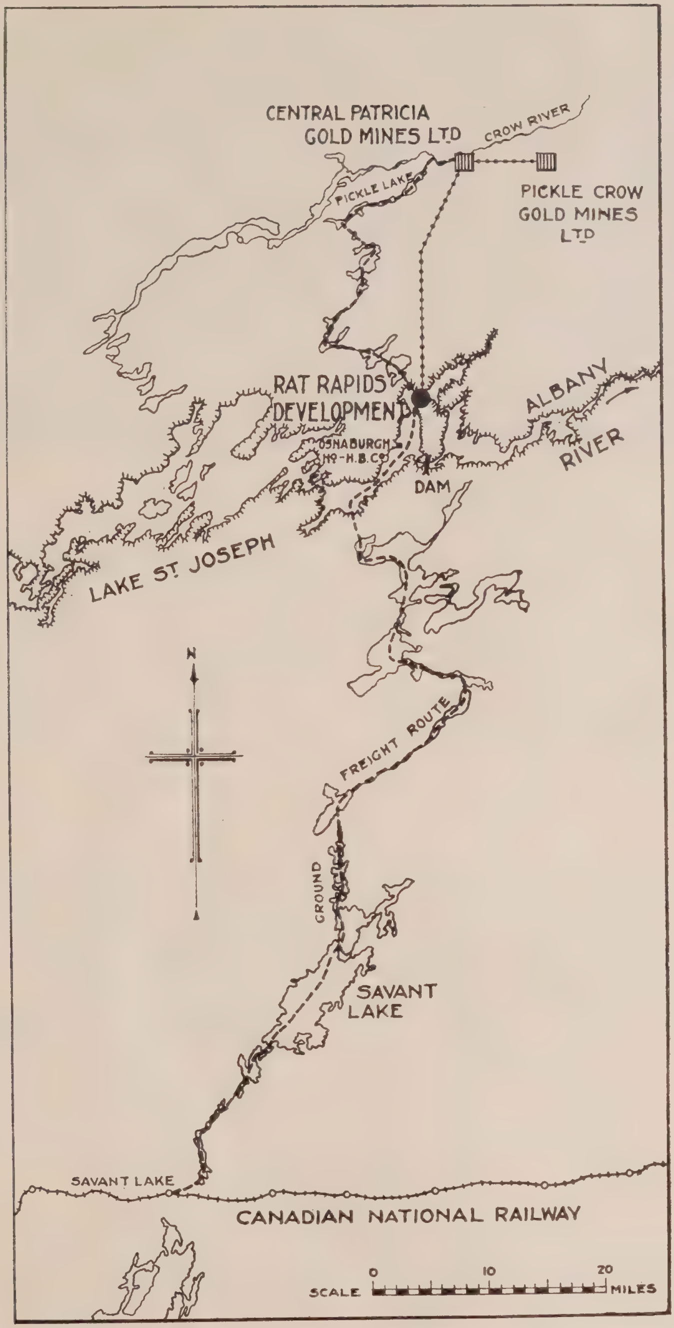
The generating unit is of the horizontal multiple-runner type, and was available from storage at one of the Commission's existing plants.

The turbine is a four-runner Francis unit designed for open flume setting. New runners were provided to adapt the turbine to the head conditions at this site. Speed control is obtained by an oil pressure governor.

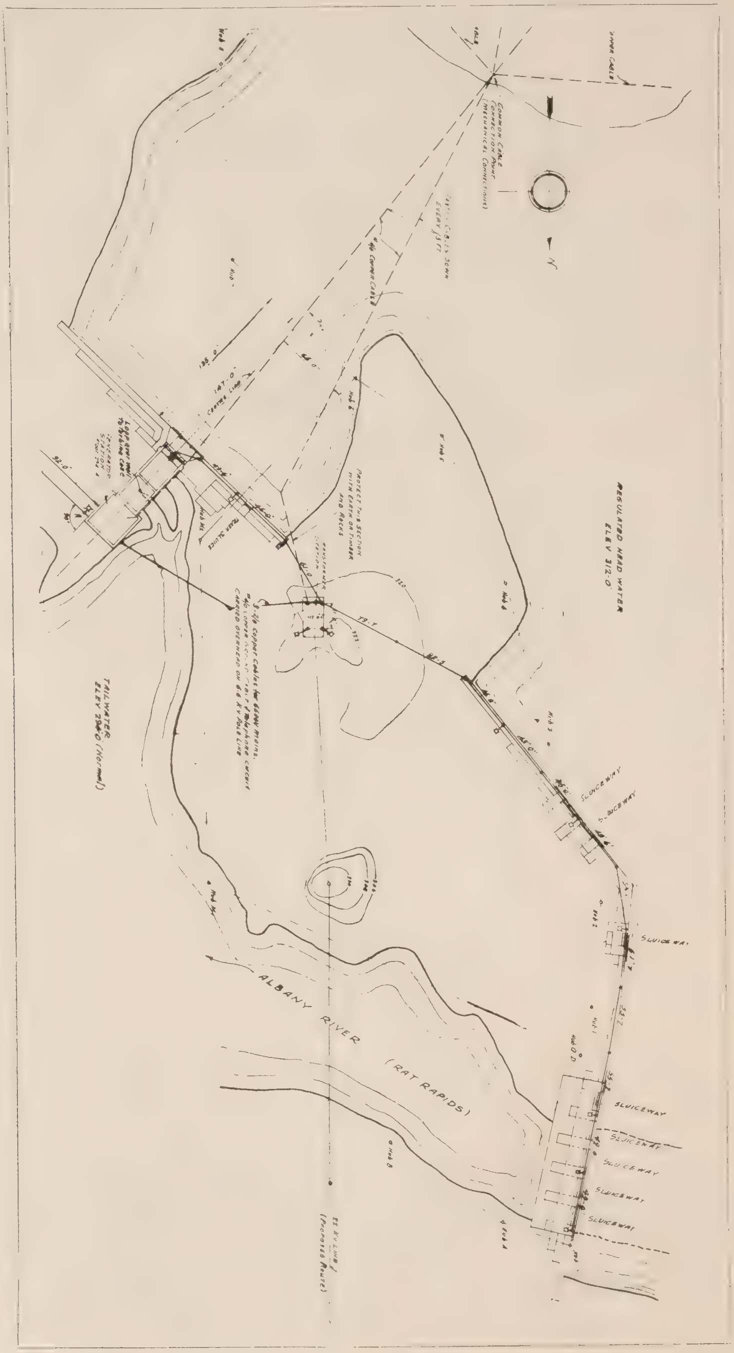
The generator is rated 2,000 kv-a., 3-phase, 60-cycle, 6,600-volt, 164 rev. per min. 85 per cent. power-factor. The generator field current is obtained from a compound-wound exciter, belt-driven from the generator shaft. Hand regulation of the field current is obtained through manually-operated exciter and main field rheostats. A hand-operated 400-ampere, 600-volt carbon circuit-breaker, with 24-volt d.c. trip coil, is provided in the main field connections.

The 6,600-volt power supply from the generator to the outdoor step-up

*Osnaburgh, Hudson Bay Post, Lake St. Joseph, Albany River.*




*Map showing location of Rat Rapids development, the freight route and the transmission line.*




Key plan of Rat Rapids development.

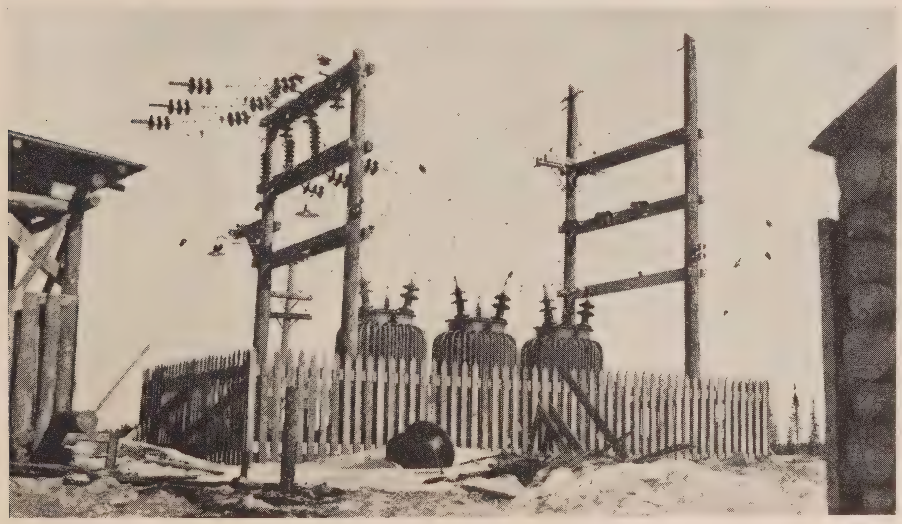
*Power house, Rat Rapids development.*

transformer bank is controlled by a 600-ampere, 7,500-volt, manually-operated, oil circuit-breaker, equipped with a 24-volt d.c. trip.

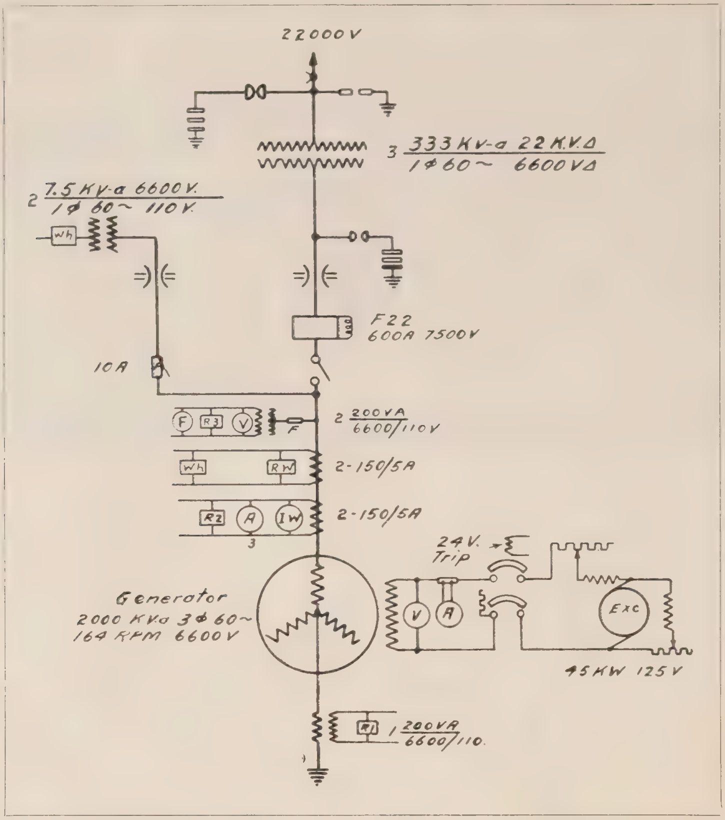
A 12-cell, 24-volt battery is the source of energy for the tripping circuits. The battery is kept continuously under charge by a suitable rectifier.

The relay protective system consists of both balanced voltage and over-voltage type relays, also excess current relays. Either the oil circuit-breaker handling the 6,600-volt output from the generator, or the carbon circuit-breaker in the generator field circuit, is tripped out by these relays, depending upon the character of the fault.

The station output is recorded on a



*Step-up transformers and pole structure.*




*Single line wiring diagram.*

graphic watt-meter, and also on a watthour meter. The indicating instruments, comprising ammeters, voltmeter, frequency indicator and wattmeter, together with the recording meters and relays, are mounted on ebony asbestos panels.

Power for such purposes as cottage, station and outside lighting, and service to the radio equipment, is obtained from two 7.5 kv-a., 6,600/110-220 volt outdoor type transformers. These transformers are mounted on a pole structure close to the generating station.

The main transformer station consists of a pole type structure. An overhead line from the generating station supplies power to the transformer bank, consisting of three Packard 333 kv-a., single-phase, 60-cycle, o.i.s.c. transformers having a transformation ratio of 6,600/22,000 volts. No high-voltage oil breaker has been provided. The transmission line can be disconnected from the transformer station and grounded when necessary by means of suitable clamps. Lightning arresters and coordinating gaps are provided and connected to the high-voltage side of the transformers. Lightning arresters have also been provided and installed

*Downstream view of the north Cedars channel dam.*

at the generating station on the 6,600-volt mains.

A grounding system for all electrical apparatus at the development was secured by radiating No. 0000 bare copper cables through a muskeg area located in the forebay about 500 feet in a south-westerly direction from the powerhouse, which was the only suitable area available for grounding purposes. All generating and transformer station equipment is connected to these grounds by cables laid in the forbay channel.

The power is transmitted at approximately 22,000 volts to the Central Patricia and Pickle Crow gold mines, over a transmission line erected on wood poles which were cut locally.

*Operator's cottage, Rat Rapids development.*

# Arc Welding in the Construction of the Administration Building

**By W. D. Walcott, Inspecting Engineer, H.E.P.C. Laboratories**

THE shielded arc process of welding was used in the fabrication of the piping for the heating system of the Commission's new Administration Building with marked success. We understand that it is the first time that this process has been used in Toronto in fabricating work of this description. As is well known it produces welds of approximately the same tensile strength, ductility and resistance to impact as mild steel and is one of the comparatively recent advances in the art of welding.

When the plans for the new building were first being considered, due to the proximity of the Toronto General Hospital and the consequent necessity for keeping noises to a minimum during construction, it was proposed to have a structural steel frame, which would be shop riveted and field welded. These plans were subsequently abandoned and the design was changed to reinforced concrete. The use of welding on the building was therefore confined chiefly to equipment in connection with the heating system, and for tanks for domestic hot water supply, and for the condensate receiver.

## Details of Heating System

The following is a description of the heating system of the new building:

The boiler is coal fired with a heating capacity of 15,000 square feet. From the top of the boiler a 10-inch line runs back to a 10-inch distribution steam header. There are six branches from this header, details of which are as follows:

*Branch No. 1.* South and west zone control to radiators consisting of a 4-inch diameter line reducing finally to 2½ inches in diameter.

*Branch No. 2.* East and north zone control to radiators consisting of a 5-inch line reducing finally to 2½ inches in diameter.

*Branch No. 3.* Pent house unit heater, consisting of 3-inch diameter on the run, reducing to 2½ inches in diameter on the riser.

*Branch No. 4.* Air conditioning line to basement and sub-basement consisting of 5-inch line.

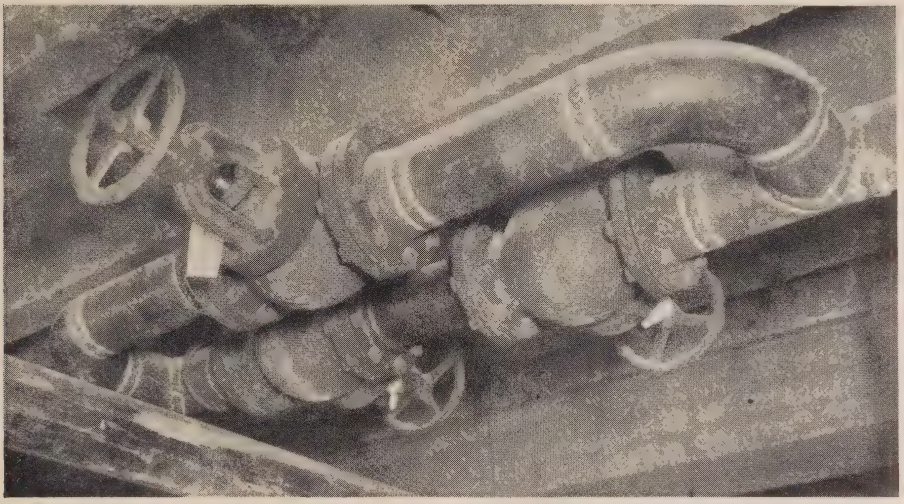
*Branch No. 5.* Hot water tanks and receiving tank line, consisting of 2-inch diameter line reducing to 1½-inch diameter and ¾ inches diameter.

*Branch No. 6.* Change-over line from existing 6-inch line to new boiler.

Each branch, with the exception of the line to the existing boiler, is equipped with reducing valves, a by-pass, and three globe valves, the reduction being from 15 lb. pressure to the pressure required.

No. 1 Branch, south and west zone control line, travels west along the south and north along the west wall feeding all radiators located along the south and west wall.

No. 2 Branch, east and north zone control line, travels east to east wall then north to the north wall;



*Five-inch bye pass.*

then west, feeding all radiators on the east and north wall.

No. 3 Branch, pent house unit heater line, travels from the basement to pent house to supply the unit heaters.

No. 4 Branch, air conditioning line, runs west and north for a short distance and then turns downward to the booster heaters and pre-heaters in the basement and sub-basement. The pre-heaters raise the temperature of the incoming outside air before reaching the fans and the booster heater raises the temperature of the recirculated air and outside pre-heated air. These booster heaters are placed inside feed ducts on the discharge side of the fan.

No. 5 Branch, hot water tank line, runs east to the hot water tank coil to heat water for domestic use. This tank is heated with a jacket heater in summer.

No. 6 Branch, change-over line, is a 6-inch line from the distribution heater in the new building to steam header in the existing building. This is a two-way feed with a shut-off valve in the old building. This makes it possible to use a combination of all or any of the boilers in either building to supply the heating requirements for both buildings.

All of the above lines feed into a drip trap which connects to the return lines which finally reach a return header in the south-east corner of the sub-basement. A duplex vacuum pump takes the condensate from this point to a receiving tank in the basement. This entails pumping the condensate up eighteen feet to two boiler feed pumps which transfer it back to the boiler which is in operation.

### Specification

The following were some of the most important clauses in the specification:

1. Welders to qualify were required to make satisfactory test pieces in the flat, vertical and overhead positions.

*Ten-inch steam header with branch lines.*

2. All welds to be made by the shielded arc process.

3. All pipe of thickness less than 13/64 in. to be welded with the open square butt type joint. Pipe of thickness greater than 13/64 in. to be bevelled to an angle of 45 deg. This meant that pipe of $2\frac{1}{2}$ inches or less could be welded without bevelling and that standard pipe larger than $2\frac{1}{2}$ inches in diameter had to be bevelled.

4. All welds except the very smallest size to be made in two passes. This permits advantage to be taken of the annealing effect of the cover bead on the first pass.

5. Provision was made for a test of 125-lb. per square inch pressure on all joints. Peening or caulking was not allowed as a method of repairing leaky portions which were corrected by chipping out and re-welding.

### Details of Welding

The general method of assembly was to weld two long sections of pipe together on the floor in the downward position. The pipe was rolled as the welding progressed so that the weld metal was always deposited in a downward position. Fittings such as elbows were also welded in this manner on the ground. Sections of pipe thus assembled were then placed in the hangers and welded to other sections in the same way as those which were welded on the ground. In places where it was not possible to rotate the pipe, tie-in or position welds were made. The technique used in making this type of weld called for a combination of downward, vertical and overhead welding.

The types of connections used included straight butt welds, tees, and reducing joints. The latter were made by slitting the pipe of larger diameter longitudinally at three or four points equally spaced around the diameter of the pipe, with the acetylene torch. The pipe was then hammered evenly until the diameter conformed to the diameter of the smaller pipe. The edge of the pipe was then bevelled and the slits were welded. The butt joint between the two pipes was also welded.

The various sizes and number of welds made were as follows:

| Diameter | Quantity |
|---|---|
| $\frac{3}{4}$ in. | 8 |
| $1\frac{1}{4}$ in. | 9 |
| $1\frac{1}{2}$ in. | 3 |
| 2 in. | 21 |
| $2\frac{1}{2}$ in. | 38 |
| 3 in. | 52 |
| $3\frac{1}{2}$ in. | 19 |
| 4 in. | 36 |
| 5 in. | 54 |
| 6 in. | 14 |
| 10 in. | 10 |
| Total | 264 |

Pressure tests made after completion of the welding and the erection of the valves did not disclose any leaks either in the welded joints or in the wrought iron piping.

### Tanks

The tanks for the domestic hot water supply and the condensate receiver were of similar design. They were about three feet in diameter and about nine feet long. The following were some of the more important clauses in the specifications:

A. Shielded arc process of welding to be used in fabrication.

B. All welds to be made in at least two passes.

C. In testing for water-tightness a cold water pressure test to be applied. The pressure was to be raised to 50 per cent. above the working pressure and then all seems were to be hammered. The pressure was then to be released. Following this, the pressure in the tank to be raised to twice the working pressure and then examined for leaks. All leaky portions to be cut out and re-welded. Peening or

*Five-inch and six-inch lines with breeching in the background.*

caulking not to be allowed as a means of repairing leaks.

No difficulty was experienced in getting these tanks to stand their final pressure of 200 lbs. per square inch without leaks.

The specifications required the interior of the hot water tanks to be given a protective coating. Due to the size of the tank galvanizing after fabrication was not feasible. This difficulty was overcome by the application of six sprayed zinc coatings totalling ten thousandths of an inch.

### Conclusions

The applications referred to are examples of the ever increasing use to which arc welding may be put, as a means of fabrication. Its success in reducing costs, in saving time, and in turning out a more efficient product than was obtained by older methods, bespeaks a wider scope in its applications in the future.

Acknowledgment is made of the assistance of Mr. W. V. Morris of the Electrical Engineering Department, in preparing the description of the details of the heating system.

# How Correct Wiring Saves

By C. E. Weitz, Illuminating Engineer, General Electric Co., Nela Park, Cleveland, Ohio

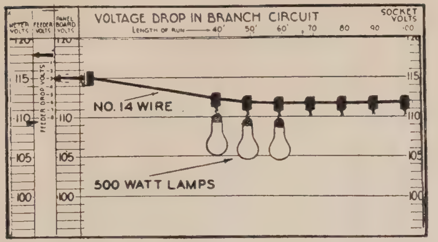
MOST industrial machines, methods and materials are appraised and purchased on unit-cost figures as related to the cost of the final factory product. Electric light wiring is one exception. Even though electrical men may figure for lowest costs on the basis of wiring cost per outlet, watts per socket or lamp renewal cost per socket per year, users yet may pay a high premium for light.

None of the elements mentioned above alone gives a true picture because they do not take into account the one thing you really want — namely, the light produced. Logically, the elements all must be properly combined in their exact relation to the actual light-producing properties of the lamp under specific conditions.

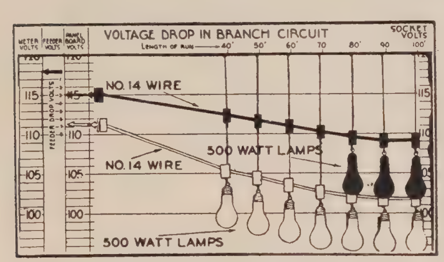
Tungsten lamps are very sensitive to voltage conditions and they produce light most economically when operated at the normal voltage for which they are designed. So hazily is this understood that this fact gets little real consideration when the more tangible expense items, such as wiring or lamp renewal costs are being studied. Unfortunately, lamps always give some light under conditions where other electrical devices would refuse to operate or else their sluggish performance would cause immediate complaint.

### Cause and Effect

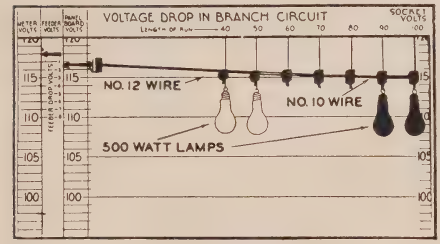
Most electrical contractors and engineers stop short of the most important element in their cost figures—that is, lamp operation. When you combine a dozen variables in a cost calculation, it takes more than a little perspicacity and patience to find the final answer. But this is more than




*A 15-ampere load carried 50 ft. on No. 14 wire produces 4 volts drop in the branch circuit voltage.*




*A 15-ampere load carried 100 ft. on No. 14 wire produces 8 volts drop in the branch circuit.*




*To maintain normal socket voltage with normal circuit capacity. The minimum wiring specifications specify No. 12 wire for runs up to 50 ft., and No. 10 wire for runs from 50 to 100 ft.*

a fine theoretical problem. It is the real background to wiring practice.

These economic relations, built into a mechanical animated chart by G. S. Merrill, of Nela Park, give a most discerning analysis of an otherwise confusing problem. The charts reproduced herewith are photographs of the mechanical calculators. One shows graphically the relation of lighting load and wiring on resultant voltage drop and gives the actual operating voltage at the lamp socket. Thus we see the part wiring plays in causing low voltage operation of lamps.

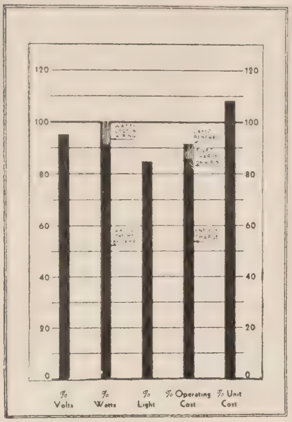
The effect of these same under-voltage conditions are interpreted by a second chart, which combines all of the factors entering into the cost of light which the user must pay for. These include the interest on the investment in wiring, depreciation, the cost of current, light delivered and lamp renewal cost—all combined in proper relation to give the final answer in terms of light received per dollar spent.

### Skimpy Wiring Costly

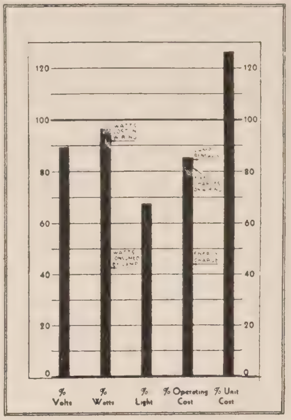
Poor voltage conditions cause erratic lamp performance, with lamps giving the least light when it is needed most. A wiring system, adequate and reasonably economical initially, may soon be overloaded and inefficient unless provision is made by installing sufficient copper to give extra capacity.

The cost of wiring may be double or quadruple the cost of extra capacity when the job is first put in. Poor voltage conditions may dictate complete rewiring, but conditions oftentimes can be somewhat relieved by strengthening feeders and by better balancing of load on three-wire and three-phase circuits.

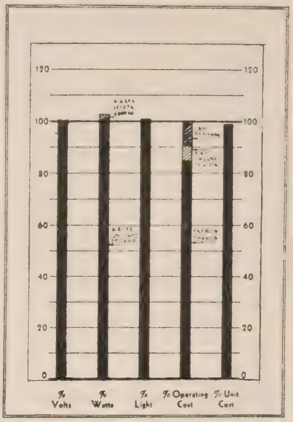
No. 14 wire can carry 15 amperes safely and satisfies Code safety requirement for 15-ampere branch circuits regardless of the length of run. It cannot carry this load more than 25 feet without more than a two-volt




*A 15-ampere load carried on No. 14 wire, resulting system operating efficiency.*




*Frequently branch circuits are heavily overloaded producing excessive voltage drop and excessive inefficiency.*




*With normal socket voltage and normal circuit capacity.*

*The True Operating Economy of a Lighting System cannot be measured by any single item of current cost, lamp cost, or investment cost, but in terms of how these factors combine to produce the Lowest Unit Cost of Light as shown in the last column of these charts.*

drop. This load at 50 feet would produce four volts drop and at 100 feet eight volts drop in addition to the drop in the feeder. Thus, the saving by using minimum permissible wire size quickly is dissipated in lower operating efficiency, since the wattage lost in skimpy wiring merely heats the wires when it should be producing light at the lamps.

### Wiring Specifications Developed

National or local electrical codes have for their purpose a minimum standard for safety and do not insure adequate or efficient electric lighting systems. Competitive bids, without adequate specifications force low estimates based on minimum safety code standards; this usually results in early obsolescence and higher cost per unit of light delivered.

The wiring specifications which follow, briefed from recommendations by the wiring committee of the National Electric Light Association, furnish a standard of adequacy for present and future needs, as well as a definite basis on which to prepare and submit electrical wiring bids. Building owners should always insist upon more comprehensive wiring specifications insuring against obsolescence and inefficiency, rather than mere conformance with Code requirements.

We now quote from the specifications we have mentioned:

"The following specification defines the minimum limits of wiring installations for lighting and other applications of electricity commonly supplied from so-called lighting circuits that will provide adequate carrying capacity and reasonably small voltage drop.

"This specification applies only to installations for connections to 115-volt or 115-230-volt distribution systems and not to wiring for the supply of energy to power equipment except so far as it is fed through the lighting feeders and panelboards.

"As the requirements given herein are minimum, it is recommended that the installation be increased and elaborated upon in proportion to the design, scale and appointment of the structure.

"There shall be one branch circuit for general or localized general lighting for each unit of area shown in the following table. A three-wire circuit is to be considered as two circuits, and a four-wire, three-phase circuit as three circuits in applying this rule. If local rules limit branch circuits to less than 1,000 watts, the area factors should be proportionately reduced.

| Use of Space | Floor Area per Circuit |
|---|---|
| Storage of bulk materials | 1,200 sq. ft. |
| Rough work, materials handling | 600 sq. ft. |
| Medium work, ordinary machine and hand work, offices | 400 sq. ft. |
| Fine bench and machine work, drafting | 200 sq. ft. |
| Extra fine work and where obstructions are present | Spec. design |

"In exceptional cases wattages may be specified on the plans for which the circuit provisions given above are not adequate. In such cases branch circuits shall be so arranged that, based on such specified wattage, the initial load on any circuit shall not exceed 1,000 watts, except in the case of a single lamp of larger wattage.

### Wire Sizes

" Wire no smaller than No. 12 shall be used in branch circuits. For runs of over 50 feet from the panelboard to the first outlet, no wire smaller than No. 10 shall be used for that portion of the circuit, and no wire smaller than No. 12 between outlets.

"Runs exceeding 100 feet from the panelboard to the first outlet shall be avoided wherever practicable by relocation or addition of panelboards. Where such runs cannot be avoided, the areas specified in Section 4 shall be reduced by 40 per cent. and the initial load on any circuit shall not exceed 600 watts, except in the case of a single lamp or greater wattage when No. 8 wire shall be used.

"When conduit is *concealed*, each conduit shall be large enough to permit the subsequent installation of one additional circuit for every five or less circuits it contains.

### Convenience Outlets

"Convenience outlets shall not be connected to branch circuits which supply outlets for general illumination.

"There should be at least one convenience outlet circuit for each 1,200 square feet of manufacturing space and one for each 2,400 square feet of storage space and at least one outlet in each bay.

"No wire smaller than No. 12 shall be used for convenience outlet circuits. Runs exceeding 100 feet from panelboard to the first outlet should be avoided wherever practicable by relocation or addition of panelboards. Where such runs are not avoidable, no wire smaller than No. 10 shall be

used to the first outlet and no smaller than No. 12 between outlets.

"Where devices rated at 500 to 1,650 watts input are likely to be connected, No. 10 and No. 8 wire shall be used instead of No. 12 and No. 10, respectively, as specified in the preceding paragraph.

### Panelboards

"Panelboards shall contain a minimum of one spare circuit position for each six circuits or fraction thereof in service.

"It is recommended that each circuit on panelboards be supplied with a switch in addition to the fuses, or with a circuit breaker, except that individual switches or breakers are not needed for circuits controlled by time switches. If local switches are to be used for the control of lights, the panelboard need not contain branch circuit switches.

### Service and Feeders

"The current-carrying capacity of the service wiring and/or the feeders and sub-feeders to and/or between panelboards shall be great enough to supply nine amperes to every 15-ampere branch circuit position, including spares, provided for on the panelboard or panelboards which they feed, in addition to any power requirements for heavy duty appliances or other non-lighting equipment which may be supplied through this service and/or feeders.

"*If the initial load, or load likely to be added, is greater than 1,000 watts per circuit, the nine-ampere requirements should be increased proportionately.*

"The service and feeders shall be of such size that the total voltage drop from the service entrance to any panelboard will not exceed 1½ per cent. with a load equal to the total capacity as stated in the preceding paragraph.

"A duplicate empty conduit, or provision (such as sleeves through floors and partitions) for running one at minimum cost, should be provided for each feeder to be used either for increasing the capacity, should it become necessary, or replacing the feeder in case of breakdown.

"*No considerable power load, or load requiring a high starting current, should be fed by a lighting feeder.*"

The following appeared in the *Toronto Star Weekly* as a news item from Regina, Sask., under the date of February 2.

### VOLUNTEER IS FINED $25 FOR "REPAIR" JOB

Donald Davidson thought he was expert enough to earn $1 fixing an electrical stove. He overheard a grocer, A. S. Gimpel, ask one of his daughters to telephone for an electrician to fix a balky stove. So Davidson volunteered.

The result was a terrific explosion, a shower of metallic sparks, a burned tea towel, a four-inch hole in a steam radiator and a 30-day jail term, because he could not pay a $25 fine.

"It's fellows like you that put people's lives and property in danger," commented Magistrate Turnbull. The charge was doing electrical work without a license.

# Electrical Shock — and After
## Where Do We Stand ?

By Wills Maclachlan

WHERE do we stand to-day in regard to the treatment of electrical shock? Due to the serious effect of electrical shock accidents, this is a question that is certainly being asked, not only by laymen but by the Medical Profession.

A considerable amount of study and research is reported in medical literature, but until the last ten years this has, for the most part, been the result of individual effort. Under the leadership of the late Dr. J. J. R. McLeod, when Professor of Physiology of the University of Toronto, research into electrical shock was carried out by Dr. Ian Urquhart and Dr. Clark Noble. Their work gave a new impetus to the study. Research was instituted in various American Universities, under the leadership of the Rockefeller Institute, a number of papers being published. Independent important work was carried out by Dr. Williams, Professor of Physiology of Columbia University. Recent work in the University of Toronto under the leadership of a committee, the chairman of which is Sir Frederick Banting, has been done by Dr. Ettinger. To make available to these research workers, the clinical or field information, the writer collected the exact information of a considerable number of electrical shock cases in Canada and the United States and reported upon the findings.

The problem is by no means solved; much more research and field study must be carried out and study given to the results so far obtained. Caution must be exercised in translating the findings obtained from working on laboratory animals to use upon human beings in the actual cases in the field. Those making the translation must fully realize their responsibility for the lives in their care. There are, however, certain facts that have been developed which are fairly definite and may be used as a brief summary of the present situation.

The passage of electrical current through a man causes paralysis of the higher nerve centres causing breathing to stop, preventing normal reflex nervous responses and causing lack of tone of the blood vessels.

The heart may be thrown into ventricular flutter, developing later into ventricular fibrillation. There is good evidence that this is recoverable from.

If the fibrillation passes off, expulsive beats may be induced by Adrenalin. If Adrenalin is given before fibrillation passes off, it will lengthen the fibrillation. Hence it is not safe for a doctor to administer Adrenalin unless he knows that there is no ventricular fibrillation present. The only sure test is by electro-cardiograph, which is not available in actual cases.

If the contact is of short duration the chance of recovery is better. If artificial respiration is applied without delay after shock, the chance of recovery is better. Warmth assists.

Electrical counter shock has not

proven to be of practical value. The administration of oxygen or oxygen plus $CO_2$, has not in laboratory animals been proven to be of value.

Success in resuscitation decreases in hot summer months and increases during the middle of the day.

Because of the lack of normal reflex nervous responses, the normal tests for life fail and should not be taken as evidence of death. It has been possible to resuscitate from electrical shock after hours of effort although ordinary signs of life were absent.

Because of the lack of tone of the blood vessels, it is at times fatal to allow a patient after being resuscitated from electrical shock to sit up or to stand.

Clear, simple explanations and demonstrations in artificial respiration should be given to the staff. Each member should be given the chance to act as patient and as operator. Details in printed form should be supplied. Regular practice in artificial respiration should be established. It is not enough, that the practice be carried out when there is a rainy day. A regular time should be set apart and a record made of the attendance at the practices. The great value of regular practice is in developing a habit that will assist men when they might lose their heads in an emergency. In actual cases this has been proven many times.

The five most important points to remember are:—

1. Clear the patient from the contact with the live wire or apparatus as rapidly as possible. Most patients are thrown clear.

2. Start artificial respiration by the Prone Pressure Method by well trained men without a moment's delay.

3. Use warmth such as blankets, hot water bottles, etc.

4. Carry out artificial respiration until patient breathes by himself or there are definite signs of the onset of Rigor Mortis (stiffening in death). Do not give up for at least four fours.

5. After the patient breathes, do not allow him to stand up or sit up. Transport him to home or hospital in a lying position.

As a result so far:

(1) There have been 46 awards of Canadian Electrical Association Resuscitation Medal between June, 1922 and June, 1934, to employees of Ontario Public Utilities for the saving of 39 lives from electrical shock.

(2) In one large utility over a fifteen-year period, the employees when not interfered with and where there was any chance of success, revived 64 per cent. of the cases that they attempted.

Although much has yet to be learned, the research has definitely confirmed the instructions based upon the classical work of the late Sir Edward Sharpey Schafer.

Are you and your men prepared?

# Celestial Eclipses, A.D. 1935

ANCIENT and superstitious peoples have been thrown into a state of great terror on the occurrence of an eclipse of the Sun or Moon. To them it was always an unexpected event and was taken as a sign foretelling some serious disaster which was shortly to befall their nation or the individual. That the sun would be "darkened", or the moon "refuse to give her light", apparently are references to eclipses which are to be taken as warning signs of some imminent dire calamity.

As the movements of the earth and moon have come to be more clearly understood, however, the times of occurrence of future eclipses, and other interesting details and conditions pertaining to them, have been predicted with extreme precision, and the information published, so that these events no longer come as a surprise or terror.

The present year is unique and remarkable for the number and arrangement of eclipses of sun and moon occurring therein. There will be seven,—five of the sun, solar eclipses, and two of the moon, lunar eclipses. This is the greatest number of eclipses possible in any one year, and this grouping will not occur again in any calendar year in this century; though, in the year 1982, there will again be seven eclipses but then four of the sun and three of the moon, the only other possible arrangement of the maximum number.

There are, at least, two eclipses of the sun every year and may be as many as five, and there may be one, two, or even three of the moon, or possibly none of the moon at all. When one has had the opportunity of seeing just a few eclipses of the moon, spaced several years apart, and to view possibly only one or two good eclipses of the sun in a lifetime,

however, these seem to be quite rare events.

While an eclipse is merely the obstructing of the sun's rays, totally or only partially, by the moon or by the earth, or by another planet or one of its satellites, one often casting its shadow upon the other, the laws governing the occurrence of eclipses, and the observance of other features of the phenomena, are, as a rule, much more interesting than the shadow itself.

### ECLIPSE MONTHS

An eclipse, either of sun or moon, can occur only near the times when the moon, in travelling in its orbit and being new or full, cuts through the plane of the ecliptic, i.e., the imaginary plane in which the earth moves around the sun. These times are known as "eclipse months", each about thirty days long, and follow each other successively slightly less than six months apart.

The present calendar year commenced with one eclipse month,—there being eclipses on January 5th and 19th and February 3rd. The next such period will come in midsummer when eclipses will occur on June 30th and July 15th and 30th. By the end of the year, however, the winter eclipse month will have moved forward and the seventh eclipse will take place on December 25th.

The moon's orbit is inclined slightly more than five degrees to the plane in which the earth moves and, therefore, at any other time than in eclipse months, the moon is too high in the sky, or too low, to cause an eclipse. The orbit revolves slowly to the west, however, this being the direct cause of the gradual moving forward of the eclipse months. These "months" advance by one complete year in a period of eighteen years and about eleven days,—i.e., about twenty days per year.

As an example,—in 1932, there was an eclipse of the sun on August 31st, followed by one of the moon about two weeks later. It would not be possible to have eclipses on these days in 1935, for this eclipse month now has advanced about sixty days. In 1941, however, eclipses should be occurring again in August and September as the present winter eclipse month will, by then, have advanced to these calendar months.

The eclipses of 1935 are exceptional, for in each of the two eclipse months completed within the year, there are two partial eclipses of the sun with a total eclipse of the moon placed midway between them. There must be one eclipse of the sun in every eclipse month but it is not necessary that there be any lunar eclipse.

There will be fourteen calendar years in this century in which there will be only two eclipses per year,—both of the sun.

### THE EFFECT OF DISTANCES OF SUN AND MOON

Another interesting factor which adds further variety to some solar eclipses is the relation of the distances of the sun and moon from the earth. The sun has a diameter about four hundred times that of the moon and it is about four hundred times as far away so these two celestial bodies appear nearly the same size in the heavens.

The sun varies its distance from the earth by about 3.4 per cent., however,

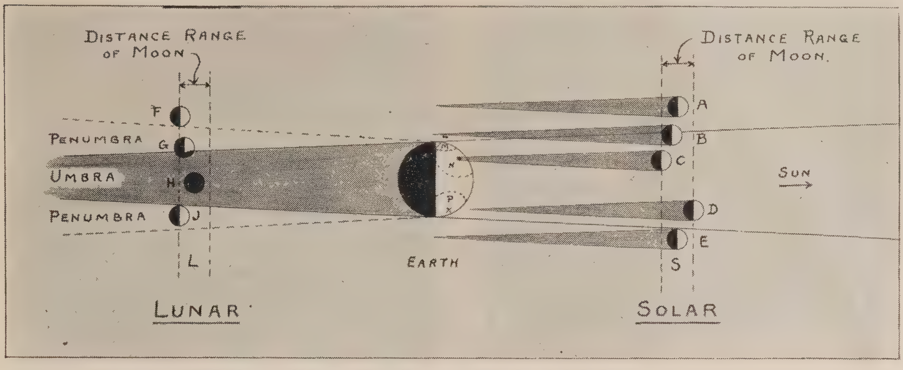



*Fig. 1—Positions of the moon for eclipses.*

*Lunar Eclipses—Visible over dark portions of earth.*

*F—No eclipse.*

*G—"Partial" only; moon in both umbra (dark shadow) and penumbra (graduated shadow).*

*H—"Total" moon entirely in umbra.*

*J—Moon entirely in penumbra; not an eclipse.*

*Solar Eclipses—Visible in certain areas only.*

*A—No eclipse.*

*B—"Partial" only, visible in limited area, M, near shadow cone.*

*C—"Total" along the dark-shadow path; partial within 2,000 miles, N, from shadow; not visible elsewhere.*

*D—"Annular" along central path; partial within 2,000 miles from path; not visible elsewhere.*

*E—No eclipse.*

*Due to the diameter of the Sun's light cone at "S" being greater than that of the earth's shadow cone at "L", solar eclipses occur more frequently than lunar eclipses.*

and the moon varies its distance by a considerably greater amount,—about 14 per cent., (Fig. 1). When the moon is crossing the sun centrally, and is nearest to the earth, it can completely cover the sun,—a "total" solar eclipse,—but if the moon be at, or near, its greatest distance, it cannot entirely cover the sun, which then will appear as a luminous annular ring surrounding the moon,—an "annular" solar eclipse. There was such an eclipse, visible in India, on August 21st, 1933,—an interesting event locally, but one which seldom inspires astronomers to travel long distances to see or photograph.

In partial eclipses, the distances of sun and moon are factors in determining the apparent curvature of the moon, or of the earth's shadow upon it.

### UNIQUE SOLAR ECLIPSES

A very interesting solar eclipse occurred on April 28th, 1930. It was first visible in the Pacific Ocean as an annular eclipse, this part of the earth being just too far from the moon to

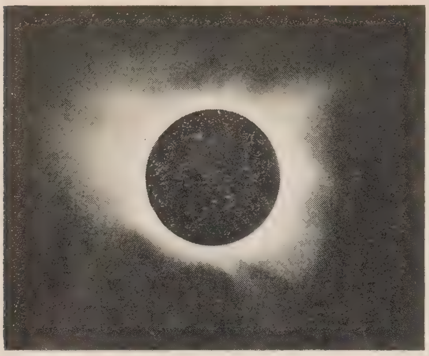


*Fig. 2—Total Solar Eclipse of January 24, 1925, showing the Sun's corona at centre of totality. (Mt. Wilson Observatory).*

receive an actual shadow, but as the eclipse progressed, the spherical shape, or "bulge", of the earth shortened the distance sufficiently that it developed into a total eclipse, with a half-mile-wide shadow, as it travelled across the western parts of the United States and Canada. It became an annular eclipse again, however, just before it left the earth. The maximum duration of totality reached was only one and one-half seconds.

The total eclipse of February 14th

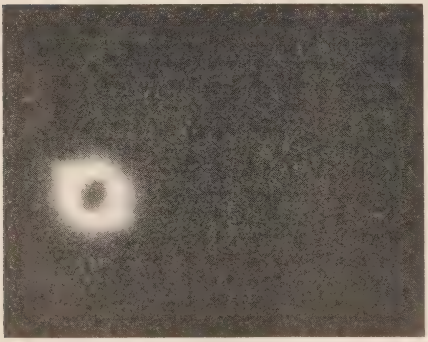


*Fig. 3—Total Solar Eclipse of August 31, 1932, showing the planet Jupiter visible during totality.*

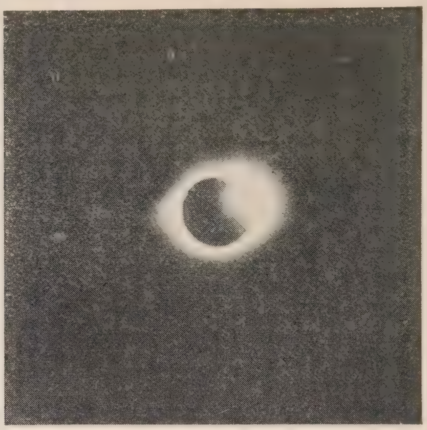


*Fig. 4—The instant of reappearance of the sun at end of totality during the solar eclipse of August 31, 1932, the corona being still visible.*

and 13th, 1934, was a paradox,—it ended on the day before it started,—according to the calendar. This was due to the shadow crossing the international date line in its path over part of the Pacific Ocean.

The total solar eclipse coming on June 8th, 1937, will have a period of totality of about seven minutes. This is an exceptionally long total phase, the maximum possible for an eclipse being only forty seconds more. It will be visible chiefly in the Pacific Ocean and end in Peru.

### The Rarity of Eclipses

To the observer stationed at any one point on the earth's land or water surface, eclipses are rare,—for three reasons,—

(a) An eclipse of the sun occurs in daytime and therefore is not visible where it is night.

(b) Every eclipse of the sun also is limited to observers who are on the central, or dark-shadow path, or

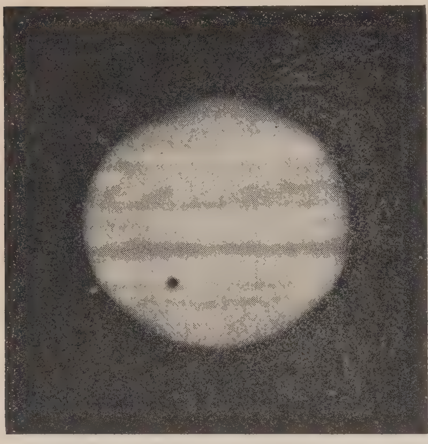


*Fig. 5—Total Solar Eclipse on Jupiter, the satellite Gannymede casting its shadow on the planet. (Mt. Wilson Observatory).*

are within 2,000 miles on either side of it, which path may actually be across some part of the earth or may only pass through space near to it.

(c) An eclipse of the moon occurs at night, when the moon is full, and therefore is not visible to observers on that half of the earth which, at the time, is illuminated by the sun.

Four eclipses of the sun this year are only partial and the fifth will be annular; so there will be no shadow path touching the earth in any of these cases, and none but the eclipse on February 3rd will be visible in Ontario. The two eclipses of the moon are total, the one on January 19th not being visible in Ontario. The second one, on July 15th and 16th, will be visible here, however, and will have a very long period of totality,—one hour and forty-one minutes at Toronto,—practically the maximum duration possible under the most favourable circumstances.

### Features of Interest to Observe

One can, of course, sit down at home, as did Aristotle, and decide beforehand what one is going to see and all that it shall mean, but in the anticipating of an eclipse, one is liable to overlook a few most interesting associated events and phenomena, until they happen and it is then realized that they are but the very natural consequences of gradually reducing sunlight, refraction and dispersion of light, or some other well known physical change.

At the time of a total solar eclipse, the features to observe are many:—

(a) The sky and landscape take on strange colours as the sun is darkened.

(b) Sunlight through trees gives crescent-shaped figures of light instead of the usual circular spots.

(c) Animals are confused; cows return to the barn.

(d) Birds go to their nests; chickens to roost; roosters crow.

(e) Temperature falls noticeably.

(f) The sun's corona, not visible at any other time, may be clearly seen during totality (Fig. 2).

(g) Brighter planets and stars appear then also (Fig. 3).

(h) The sun seems very bright on its re-appearance after totality (Fig. 4).

(j) As the eclipse passes off, it is similar to a partial eclipse (see illustration at top of article).

There is the opportunity, on the occasion of a total eclipse, to search for possible new planets near the sun,

*Fig. 6—As the moon slipped out of the earth's shadow during the lunar eclipse of May 2, 1920. (Yerkes Observatory).*

to photograph the corona and to study effects of magnetic waves and radio transmission.

During the totality period of a lunar eclipse, the moon usually is of a dim copper-red colour and the outline plainly visible. The colouring is due to dispersion and refraction of the sun's rays in passing through the earth's atmosphere where the red rays pass more freely than those of other colours, and also are bent inwards towards the moon. This colour phenomenon may not appear, however, nor the outline of the moon be visible, if the atmosphere be foggy or cloudy where the rays pass through it.

An eclipse of the sun, when total, is very spectacular and a much more impressive sight than an eclipse of the moon but probably the most important feature in either is the opportunity it affords to check the position of the moon.

Eclipses of the satellites of Jupiter by the planet itself, and also their transits across the disc of the planet (Fig. 5), occur quite frequently every month. These events are not of general interest, however, as they are observable only by means of a telescope, but are used by navigators of the seas as an accurate means of checking their chronometers. Eclipses and transits occurring with other planets and their satellites do not, as a rule, receive much attention.

### TOTAL ECLIPSE OF THE MOON— JULY 15TH AND 16TH, 1935

As with other eclipses, definite information is available beforehand in regard to time of the different phases of the forthcoming lunar eclipse, and where the phenomenon may be seen on these dates.

This will be visible throughout North and South America,—provided clouds do not interfere,—and should prove of considerable interest on account of the very long period of totality. The centre of totality will

come precisely at midnight, Eastern Standard Time.

The following information has been received from the Dominion Observatory in regard to this eclipse,—

July 15th—
10.20 p.m., E.S.T.—
The moon enters the umbra, or dark shadow of the earth, entering from the right side.

11.09 p.m., E.S.T.—
Total eclipse begins. (Period of totality, 1 hour, 41 min.)

July 16th—
12.50 a.m., E.S.T.—
Total eclipse ends.

1.47 a.m., E.S.T.—
The moon leaves the umbra,—leaving to the left.

For about one-half hour before entering the dark shadow of the earth, and also for about the same period after leaving it, the moon will appear darkened, on the left and right sides respectively, by the penumbra, i.e., the partial or graduated shadow.

The edge of the dark shadow will appear more sharp to the unaided eye than when viewed through a telescope (Fig. 6). In fact, through a large instrument, the shadow line may not even be distinguishable.

This eclipse will be another observance of one of Nature's simple phenomena, rendered the more interesting by its seeming rarity, which, in turn, is due to the inherent variety in the motions of the celestial bodies involved. It will not likely arouse fear or strike terror to the hearts of many observers but will demonstrate again the near approach to perpetual motion in heavenly bodies. The most remarkable feature about any eclipse, however, is the astounding accuracy with which man can predict its occurrence and duration—and for a total solar eclipse, the exact path of the shadow,—so far away in the future, and that the sun, the moon and the earth always keep the appointment.

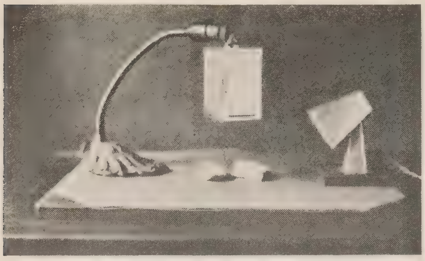
# Fluorescence, the Detective

**By F. K. Dalton, Testing Engineer, H.E.P.C. of Ont.**

"IMITATION is the sincerest form of flattery."

How strange is the seeming contradiction, for how can imitation be a sincere form of anything, real or abstract? Nevertheless, only that which is genuine, superfine in quality of material and of the highest grade in workmanship is chosen for imitation in a non-genuine and cheaper material. The intention in every case clearly is that the imitation shall be as effective in appearance, or operation, as that which is copied. In other words, it shall avoid detection by the public eye or by general public knowledge.

It would seem, however, that many people do not fully appreciate the value of some genuine gems or semi-precious materials, but are so well satisfied with an appearance and effect which can be obtained by imitation that there is a very large field for sale



*The Argon Bulb Ultra-violet Lamp set up for examination of specimens shown beneath it. To the right, a hood containing an incandescent lamp for ordinary illumination.*

of the reproductions. Genuine worth, however, will always stand the acid test of time and eventually the true will be distinguishable from the false, so, for those who value it, and want to be assured that they possess the real and genuine article,—that which is exactly what it claims or appears to be,—some method of inspection, with the use of an agent which can readily discriminate between materials, is necessary.

Such an agent, convenient to handle and one which does not in any way harm the specimen tested, may be found in the invisible ultra-violet rays, or "black light", from any one of several known sources. Certain substances submitted to these rays will fluoresce, i.e., will glow with distinctive visible colours, according to the composition of the substance, or to certain adulteration or foreign ingredients contained therein.

In nearly every case the fluorescent appearance is quite different from the normal colouring in daylight, and the usual lustre and polish are lacking. As imitations are made of other materials than the genuine, the fluorescence pronounces the verdict wherever it appears.

### Pearls

When a small particle of foreign material enters the oyster's shell, it irritates him, and he proceeds immediately to cover it with successive layers of carbonate of lime, producing the pearl. Genuine pearls of good form and size take a long time to "grow" in this way, and are valuable, so cheaper imitations appear, made of glass, fish scales, etc.

Fluorescence proves an excellent detective here, for, under ultra-violet rays, the true pearl fluoresces a light bluish or yellowish green, with a somewhat darker centre, whereas the imitations mentioned then appear brown, —a very definite difference in colour giving ready distinction of one from the other. In both cases, the specimens show a dull finish,—no lustre.

The cultured pearl is not an imitation. It is obtained by a means which merely hastens its production and tends to insure the spherical shape. Having outside layers of the same material as the real pearl, it fluoresces to the same shades of colour but does not have quite as dark a centre.

### Ivory

The ivory from the elephant's tusk fluoresces a light blue whereas varieties of false ivory give brown, as with other imitations. This again is a means of distinguishing the true from the imitation by colour of fluorescence.

In the same way teeth, whether alive or treated, will fluoresce light blue but the false tooth, of either feldspar or porcelain, does not respond

and therefore appears black. These may be much the same by daylight, but cannot pass unnoticed the detective of ultra-violet rays.

### Woods

As explained in The Bulletin of December, 1933, certain varieties of wood respond by fluorescence. Thus Black Locust, which makes a very good insulator pin, may be separated from Oak, which is also used for this purpose, by the fluorescent result, for pins made of Locust fluoresce brilliantly whereas there is no response visible from Oak pins. This is a simple means for sorting pins for one who cannot identify these woods by their grains, especially after they have become darkened by being in service for some time; a small nick with a penknife exposes enough wood for identification by fluorescence.

### Silk

In Japan, there are two varieties of tree, the leaves of which supply food for the silkworm, i.e., the Mulberry and the Silkworm Oak (Kunugi). The cocoons and raw silk are of the purest white in daylight.

Under ultra-violet rays, however, in a group of these cocoons, some fluoresce light blue whereas others are as definitely brown. Comparing sections of the limbs of the trees, it is found that the cambium layer of the Mulberry fluoresces a bright blue whereas that of the Silkworm Oak shows brown.

Fluorescence, therefore, would appear to be a satisfactory means of sorting silk according to the type of tree on which the worms are fed, which in turn may be a means of sorting the grades of silk.

### Precious Stones

Here fluorescence seems to fail. It is perhaps unfortunate that ultra-violet rays do not find visible response in the great majority of the more precious stones. For the most part, a precious stone, if it be a crystal of the pure basic material, would be colourless for the shade of colour is usually due to some foreign ingredient.

The basic materials of diamond, corundum (rubies and all colours of sapphire), emerald, topaz and quartz (amethyst, agate, onyx, etc.), do not respond. About ten per cent. of the cut diamonds fluoresce, however, blue or brown, due to a minute trace of foreign material contained within them but which may not mar the normal beauty of the stone, or be detectable by other means.

Imitations of precious stones,—either artificial gems, which are made of the proper materials, or the non-genuine "stone" of glass,—do not usually respond visibly so this detective, Fluorescence, will not likely be able to discriminate between precious stones and imitations. There are other means available, however, for detecting the differences.

### Other Fields

The above results are those obtained in the writer's experimental work with Argon bulbs and suitable filters. Others are using ultra-violet rays to detect impurities in oils, erasures and alterations in signatures on documents, or to identify certain types of materials. The uses are manifold but nevertheless somewhat limited according to the responsiveness of the specimens submitted for detection and identification.

# Do Linemen Think?

**By W. W. Palmer**

"AT 3.15 p.m. July 21, 1934, John Leigh, class A lineman, received fatal injuries while engaged in seeking radio interference on a pole at Pine and Myrtle Streets. Sparks dropped from a cut-out box on which he was tapping, and ignited his clothing. While endeavouring to extinguish the fire his left shoulder touched a primary conductor, resulting in death, apparently instantaneous.

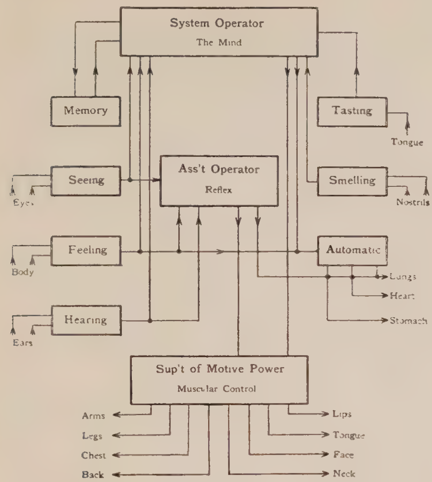
"The immediate cause of this accident was a lapse of memory on Leigh's part. Though the circumstances were severe, he should have kept his head and stayed clear of the conductor".

So ended the Board's report and, with its filing, John's official connection with the company. John Leigh, however, cannot be so easily forgotten by his wife and children or by his associates. Unfortunately, there is nothing we can do now about his case; but isn't there a little more that both men and management can do to prevent the potential cases that are certain to test severely our protective abilities?

Suppose, for instance, the Board had reported the accident as caused by improper operation of a circuit breaker. We, as engineers, would have insisted on studying the relay set-up in minute detail until a definite cause and solution had been located. On the other hand, when a trouble is found to be mental and the requirements not unusual, the problem is declared solved and warnings are issued for others not to make the same mistake.

Since all human actions originate in the brain, accidents can be said to start there too. More accidents can be prevented by a better understanding of mentalities, mental limitations, and probable reactions than by any other approach. All good safety rules and practices are based on this fact. It is in order, then, to review some of the known facts about the construction of the brain and the manner of its operation.

In the dark interior of the protecting skull the brain floats in water which equalizes pressures from external blows. It is not just a mass of cells but is accurately divided into departments, each of which has specific duties, somewhat similar to an electric-distribution system. Each station receives and sends impulses over the millions of nerve lines. In the cerebrum is located the mind, seat of conscious thought—the System Operator. From the single-line diagram can be seen how the S.O. may become confused in critical moments, for he can hardly be conscious of more than one thought at a time; yet the substations Hearing, Feeling, Seeing, Smelling, Tasting, and Memory are continually making reports. This produces distraction and prevents concentration; and yet even these warnings are not enough. John Leigh's mind was on his work in front of him while his electrical hazard was behind. Its presence could not be reported by any of the senses




*A single line diagram of the human brain.*

because voltage is noiseless, odorless, and invisible. Touch or feeling would produce unconsciousness. John needed help.

### Weaknesses in the System

The fact that Memory and the sense substations are constantly reporting and tending to confuse the S.O. is annoying but necessary. In a million years nature has developed this intricate alarm system to keep the brain conscious of its surroundings. Alcohol weakens the nerve impulses upon which the S.O. is absolutely dependent for receiving and sending impulses properly. This makes him feel happy by relieving him of those nagging annoyances and soothes him into dreamy semi-consciousness, but makes him less fitted to guard against modern high-speed hazards than primitive man with his childish brain in his simpler surroundings. The only safe way to prevent having harried brains is to lighten their burdens, keep down body annoyances, and clear troubled memories.

The second greatest weakness of the brain set-up is the time lag. You are driving rapidly and another car suddenly appears. Not only must it be photographed on your retinas, but its direction and speed are registered as moving pictures. A time lag is necessary to receive the impression of motion. The impressions are sent as nerve impulses to your Sight substation where they are analyzed (again a time lag) and the analysis forwarded to the S.O. who is, or should be, already conscious of his own speed and direction. The S.O. consults Memory (time lag), who reports the situation is serious. The Mind must then decide what to do, while a continuous stream of additional reports continue to pour in from not less than four substations (big time lag). Just about the time he has decided to put on brakes, gloomy Memory reports the pavement is wet or his brakes are not balanced. He may decide to pull to the right, but Sight reports there is a lady standing there. Having finally determined his course of action, he wires his Superintendent of Motive Power to apply the foot brakes and turn left. This operator then energizes the hundreds of nerves to as many muscle fibers in the arms and legs, being careful not to energize the "turn-right" or the "accelerator" muscles (time lag). One wonders how cars ever miss hitting each other.

A third brain weakness is Memory. Its function is to keep a continuous log of all reports reaching the S.O.

and to have them continuously ready for his instantaneous use. Like most filing clerks he can quickly locate the records last handled. That is why frequent safety meetings prevent accidents. This operator has a bad habit, however, of interrupting the busy S.O. by speaking out of his turn. When a man is in dangerous territory, Memory should not mention personal debts or last night's brawl—but he often does with unfortunate results.

### Hazards of Automatic Operations

To correct these brain faults, nature has equipped for automatic operation, the substation controlling such simple functions as heart beats, respiration, and digestion. Other operations, slightly less routine, have been delegated to the semi-automatic substation controlling reflex actions. Upon backing into a hot stove one does not resort to thought to analyze the situation. The afferent impulses from the injured area are received by Feeling who switches them direct to Reflex who flashes the different controls. By the time the S.O. with his time lag has become conscious of the pain the body is clear of the hazard.

The great danger of delegating authority to these sub-operators is that they are incapable of thinking and have no judgment or connection with Memory. For instance, John Leigh's weight was on his right foot and he was in such a strained position that the right leg was rapidly fatigued. Incessantly, Feeling reported this fact to the S.O. and to Reflex. Without Thought's or Memory's guidance Reflex would have ordered Muscular control to shift weight. For this reason it was necessary for Memory to keep the S.O. constantly informed of the 2,300-volt hazard and for him to keep Reflex in check. This he was able to do until his attention was distracted by a yell from Feeling that his chest was burning. Being forgotten for the moment, Reflex assumed authority, ordered body weight shifted; and oblivion followed. Hovering hazards, like disease germs, rush through small openings in the defense.

The tendency to use delegated authority without thought may be demonstrated by the fact that one cannot commit suicide by holding the breath. The S.O. may order it held and Automatic will refrain from sending respiration impulses even though body cells everywhere beg for oxygen through incessant requests to Feeling. This condition, however, can be maintained only until S.O. loses consciousness from lack of oxygen. Automatic then takes control and respiration begins. Automatic could not lose consciousness since he never possessed that faculty.

As a man becomes skilled in his trade or profession his brain substations take an increasing amount of the load from the S.O. Without conscious thought a trained lineman recalls the condition of his hardware, leather goods, pole, circuits, etc.; he is quiet, not too arrogant to be advised, deliberate and alert. These mental conditions help materially in forestalling accidents. Daniel Boone owed his longevity and renown as a pioneer to his mental training.

### Brain Types

The use of heads for individual needs through past generations has

developed men's brains into two distinct types—inward and outward thinkers. Inward thinkers are those who can pull the disconnects on all incoming lines and work with Memory only. To this class belong the professors, scientists, inventors, poets, etc. Their type of work requires a complete disregard to sense impressions, at will, and concentration on inward calculations. They are bad insurance risks in fast traffic or on a pole. The outward thinkers are those whose minds are trained to refrain from meditation and to concentrate on sense impressions. Linemen, boxers, bus drivers, and ball players cannot understand Mr. Einstein, but have an uncanny ability to maintain poise and mental alertness. The inward thinker slowly fuses known facts to provide new ideas. He is unconscious of his environment. The outward thinker keeps the correct reference cards already drawn from Memory's files and stands poised for instant action in any emergency.

The complexity of mental processes cannot be exaggerated. No man could do creative work in the most comfortable office if high tension electrodes were suspended behind each ear and an open elevator shaft yawned beneath his coat tails. No mind is big enough to concentrate on work and hazards at the same instant. The best minds must rapidly shuttle from one to the other. Additional abstractions should be avoided. Men prone to do original thinking; social conversationalists and mental cud-chewers should be kept in safe surroundings. To be trusted aloft a lineman should be so thoroughly familiar with his work and common hazards that they can be dispatched by Reflex, leaving the mind unimpaired to anticipate and avoid the unusual. Even if such ideals could be attained, modern industry is so complex that the most skilled men can live to old age only when thoughtfully supervised. Often one has been saved by an associate, a professional prompter, softly saying: "Don't raise up, Buddy".

### The Toll of Negligence

John Leigh's demise came from two common weaknesses among skilled workmen. First, they accumulate a feeling of invulnerability and assume that literal interpretation of safety rules is intended for less skilled men. The second, and fatal, weakness comes from overrating their abilities to keep their heads. The moment John's S.O. ignored all impulses but one he was killed, not by lack of thought, but by inward thinking, by concentrating on one impulse. When employers promote men by seniority, or on any other basis, to class A positions, without first ascertaining their abilities to keep and use their heads, they do a great injustice to the men, to their families, and to their companies.

It is our conclusion, then, that John Leigh was guilty of gross negligence on the following points:

1. He worked near live conductors without first applying rubber protectors.

2. He worked on and below equipment subject to exploding, breaking, or falling upon his person.

3. He used a stick too short to keep his body in the safety zone.

4. He placed his body in such position that involuntary movements would be dangerous.

5. His actions showed gross disrespect for rules that he knew were for his own protection.

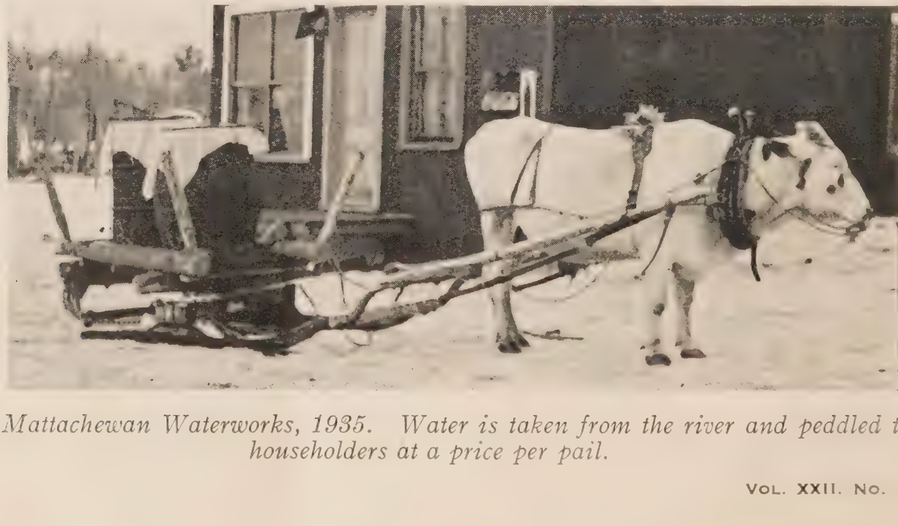
And his company was negligent on two counts:

1. For assuming any man could work safely under such conditions without immediate supervision.

2. For allowing any employee to acquire carelessness in applying safety rules.

The final decision goes to Death. He always wins the last round from those who ignore proven safe practices.—*The Electric Journal.*

*Southern half of Mattachewan, Ont., first mining town served by Hydro.*



*Mattachewan Waterworks, 1935. Water is taken from the river and peddled to householders at a price per pail.*

THE
BULLETIN
Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario
620 University Ave. Toronto
Subscription Price $2.00 Per Year

# New Addition to Hydro Administration Building

ON July 1st the head office staff of the Hydro-Electric Power Commission of Ontario was consolidated under one roof at 620 University Avenue where a new extension of the existing building will accommodate those departments of this large organization which, for many years, have been located in some fourteen other buildings throughout Toronto. This new extension, modern in motif, is a reinforced concrete structure of six storeys and basement having heavy steel cored columns and being faced with Queenston limestone. A polished black granite base is used for contrast and gives the structure solidity.

Originally this new addition was designed for 18 storeys but the present commission decided to build only six storeys, eliminate the entrance and entrance hall and make it strictly a utilitarian extension to the existing main building. It can be considered therefore as a large new block of offices built strictly for utility. As the building is designed for an ultimate 18 storeys, provision is made structurally so that it can be increased in height without undue expense or major changes.

While there are a number of new features embodied in the services of the new building, there is nothing elaborate or costly. The electrical services, for instance, have been designed strictly for utility, but are adequate and very flexible. All lighting outlets, for example, are wired for 1,000 watt lamps and similarly heavy copper is installed to take care of heavier future loads.

Electric service is brought in to the building from the Toronto Hydro-Electric System at 208/120 volts, 3-phase, 4-wire, from a transformer vault containing three 100 kv-a., single-phase transformers and located underground adjacent to the building. The main distribution switchboard, located in the basement, consists only of three panels: (1) Toronto Hydro metering; (2) 1,200 ampere feeder air circuit-breaker, and 325 ampere Nofuz service breaker; (3) 1,600 ampere feeder air circuit-breaker, and indicating meters.

## CONTENTS

Vol. XXII No. 7

JULY, 1935



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

One ingenious new feature found in the basement is the new design for a cable trough. The steel trough is rectangular and mounted flush with the ceiling. Access to it is obtained by removing a centre panel which is about one-third the size of the trough. The bottom of the trough is bent up into two flanges which act as hangers for the feeder cables and also carry the removable panel. To remove a feeder cable, therefore, it is only necessary to take off the removable bottom section and lift out the cable from one of the side troughs.

Another interesting feature of the electrical layout is found in the hanging type copper bus risers which are suspended from the top floor. There are two riser shafts, one set of lighting buses in each, although provision is made for a power set in one shaft and also for doubling up the copper of each lighting bus. Each bus conductor at present consists of one 4-in. by ¼-in copper bar passing though guides at convenient intervals. Cable taps are taken off at each floor, feeding the Nofuz distribution panels.

To help distribute the load evenly over the three phases, any three consecutive breakers in the distribution panels constitute a 3-phase group. This arrangement also greatly simplifies wiring.

Careful layout work was required in order to locate an underfloor duct system in the rib-slab type floor. Double half-round 4-in. Cornwall fibre ducts were placed two in parallel, to give lighting and power, and telephone and signal services. Such a system enables taps to be taken off at any convenient point, depending upon the various office arrangements.

In keeping with modern trend the complete lighting installation is fuseless, circuit-breakers being used in all distribution panels. Furthermore, for all wall switches, double boxes have been used to allow for any future additions, changes, etc. All branch wiring is No. 12; 20 ampere breakers are used for office area lighting and 15 ampere breakers for corridor and baseboard lighting.

Office lighting units are essentially modern in design and are of both totally and semi-indirect types. Wiring and fittings will accommodate 1,000-watt lamps, although in most cases 300-watt lamps have been installed initially. Spacing of units varies with structural details, but averages about 10 ft. by 10 ft. between centres. On the ground and second floors they are mounted 2 ft.

*New Extension to Hydro Administration Building.*

9 in. from the 12 ft. 6 in. ceiling, but on other floors they are mounted 2 ft. from the 10 ft. 6 in. ceilings.

Sproatt & Rolph were the consulting architects for this new extension, and Anglin-Norcross, Ontario, Ltd., the contractors. The electrical wiring and installation was made by Canada Electric Company.

The main electrical equipment was supplied by the following manufacturers: Lighting fixtures, Canadian Westinghouse Co., Curtis Lighting, Northern Electric Co., and J. A. Wilson Co.; main switchboard and disconnects, Eastern Power Devices; circuit-breakers, Bitzer & Co.; distribution panelboards, Amalgamated Electric Corporation; wall switches, Arrow, Hart & Hegeman; underfloor duct, Canadian General Electric Co. Two variable voltage, direct traction elevators were manufactured and installed by Otis-Fensom Elevator Co.

# Chairman T. Stewart Lyon's Letter of Submittal of the Twenty-Seventh Annual Report

*To His Honour*

THE HONOURABLE HERBERT A. BRUCE, R.A.M.C., M.D., F.R.C.S.,
*Lieutenant-Governor of Ontario.*

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour the Twenty-seventh Annual Report of The Hydro-Electric Power Commission of Ontario for the fiscal year ending October 31, 1934.

This Report contains a record of the Commission's activities in construction and administration and embodies also its financial statements for the year ending October 31, 1934. It also presents, for the calendar year 1934, financial statements and statistical data relating to the municipal electric utilities operating in conjunction with the various systems of the Commission and supplying electrical service to the citizens of the Province.

The Report includes also details of the operation of the Northern Ontario properties which are owned by the Province and operated by this Commission, under an agreement by which any deficits incurred in operation are provided from the provincial treasury, and any surplus funds remaining from operations are transferred to the treasury.

The financial statements, statistical data and general information given, are so presented as to provide a comprehensive survey of the Commission's operations. For the information of Your Honour and the Members of the Legislature comparative statements have been compiled showing, for the several systems of the Commission, for a number of years past, the total cost of power supplied to the co-operating municipalities and to other consumers of each system, including the total cost of power purchased under contract for each system; the revenues of each system; and the additions made to, or the withdrawals from, the various reserve funds of each system.

### SEVEN YEARS POWER LOAD

The following tables (Tables I, II, III, IV, V and VI) show the distribution of primary and secondary power to all systems, the cost of operation including the amounts paid for purchased power, and the rapid increase of the use of electric energy in the gold fields of Northern Ontario during the past seven years. The primary load in the Niagara system at the end of 1934 was still materially less than at the end of 1929, the period of greatest consumption, as the figures for the month of December clearly show, but the expansion in the secondary power load in all systems brought up the total primary and secondary power supplied in December, 1934, to the highest figures yet recorded.

### MUNICIPALITIES SERVED

At the end of the fiscal year, the number of municipalities served in Ontario by the Commission was 760. This number included 27 cities, 96 towns, 270 villages and police villages, and 367 townships. With the exception of 14 suburban sections of townships known as voted areas, the townships and 93 of the smaller villages are served as parts of 171 rural power districts.

### RURAL LINE EXPANSION

The total mileage of rural lines constructed, or under construction, at the end of October, 1934, amounted to 9,461 miles, of which 183 miles represented the construction program during the year 1934.

TABLE I

DISTRIBUTION OF PRIMARY POWER TO SYSTEMS

20-MINUTE PEAK HORSEPOWER—SYSTEM COINCIDENT PRIMARY PEAKS

| System | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | | | | October | | | |
| Niagara system, 25-cycle.. | 811,973 | 931,261 | 879,518 | 805,630 | 839,946 | 848,793 | 856,434 |
| Dominion Power & Trans. | ........ | ........ | 58,579 | 48,659 | 43,968 | 45,710 | 50,670 |
| Eastern Ontario system... | 77,654 | 82,299 | 87,990 | 85,857 | 80,544 | 86,890 | 91,716 |
| Georgian Bay system..... | 20,082 | 22,118 | 23,355 | 26,356 | 25,666 | 23,887 | 24,488 |
| Thunder Bay system..... | 48,910 | 77,117 | 73,968 | 51,600 | 58,140 | 66,187 | 60,188 |
| Manitoulin rural power dist. | ........ | ........ | ........ | ........ | ........ | 80 | 88 |
| Northern Ont. properties: | | | | | | | |
| Sudbury district....... | ........ | ........ | 12,935 | 10,724 | 7,574 | 12,466 | 12,466 |
| Abitibi district......... | ........ | ........ | ........ | 17,800 | 11,340 | 15,777 | 31,501 |
| Nipissing district....... | 3,170 | 3,599 | 3,745 | 3,689 | 3,751 | 3,539 | 3,840 |
| Patricia district........ | ........ | ........ | 1,582 | 1,912 | 2,048 | 2,627 | 2,828 |
| Espanola district....... | ........ | ........ | ........ | ........ | ........ | ........ | 509 |
| Total.............. | 961,789 | 1,116,394 | 1,141,672 | 1,052,227 | 1,072,977 | 1,105,956 | 1,134,728 |
| | | | | December | | | |
| Niagara system, 25-cycle.. | 891,904 | 969,123 | 902,392 | 828,200 | 838,338 | 879,893 | 901,877 |
| Dominion Power & Trans. | ........ | ........ | 61,528 | 56,166 | 48,525 | 51,743 | 54,021 |
| Eastern Ontario system... | 81,548 | 90,255 | 93,560 | 91,253 | 86,716 | 91,924 | 96,783 |
| Georgian Bay system..... | 21,595 | 22,961 | 25,591 | 27,531 | 26,424 | 25,496 | 26,816 |
| Thunder Bay system..... | 66,300 | 64,588 | 61,300 | 50,300 | 55,570 | 54,704 | 69,658 |
| Manitoulin rural power dist. | ........ | ........ | ........ | ........ | ........ | 84 | 108 |
| Northern Ont. properties: | | | | | | | |
| Sudbury district....... | ........ | ........ | 10,724 | 11,059 | 9,853 | 12,802 | 13,003 |
| Abitibi district......... | ........ | ........ | ........ | 13,000 | 13,000 | 14,745 | 32,842 |
| Nipissing district....... | 3,248 | 3,492 | 3,654 | 4,088 | 3,799 | 3,901 | 4,008 |
| Patricia district........ | ........ | ........ | 1,521 | 1,926 | 2,058 | 2,735 | 2,855 |
| Espanola district....... | ........ | ........ | ........ | ........ | ........ | ........ | 535 |
| Total.............. | 1,064,595 | 1,150,419 | 1,160,270 | 1,083,523 | 1,084,283 | 1,138,027 | 1,202,506 |

NOTE.—The above figures represent primary loads, and are strictly comparable from year to year. The figures which have appeared in this table in former years have represented total loads on the basis in use at the time; for example, on page viii of the 1930 report, the October 1930 load is shown as 1,000,670 horsepower. In addition to the primary load of 879,518 it contained at-will export 113,592 horsepower and a transfer to the Georgian Bay system amounting to 7,560 horsepower. While the latter is a primary obligation upon the Niagara system so far as generating resources go, it does not represent Niagara system load and as this load is included in the Georgian Bay system figures it must be excluded from those of the Niagara system. The correction has been made in all subsequent years.

In order to encourage a more liberal use of electric power by Ontario farmers, studies were made during the year which had for their objective the further reduction of rural rates and the beneficial utilization of surplus energy. As a result of these studies three major benefits were approved, as follows:

*Free Service Inducements*

Commencing November 1, 1934, and during a period of three years thereafter, the Commission will provide current, free of charge, to operate electric washing machines, licensed alternating current radios, and electric pumps to provide water under pressure for household sanitary systems.

The offer is available to all present farm and hamlet users (excepting summer cottages) now supplied from

TABLE II

DISTRIBUTION OF POWER TO SYSTEMS—TOTAL PRIMARY AND SECONDARY

20-Minute Peak Horsepower—System Coincident Peaks

| System | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | October | | | | | | |
| Niagara system, 25-cycle.. | 878,327 | 948,412 | 1,038,110 | 860,630 | 867,446 | 1,055,697 | 1,071,046 |
| Dominion Power & Trans. | ........ | ........ | 58,579 | 48,659 | 43,968 | 45,710 | 50,670 |
| Eastern Ontario system... | 77,654 | 82,299 | 87,990 | 85,857 | 80,544 | 86,890 | 121,823 |
| Georgian Bay system..... | 20,082 | 22,118 | 23,355 | 26,356 | 25,666 | 23,887 | 24,488 |
| Thunder Bay system..... | 48,910 | 77,117 | 73,968 | 51,600 | 65,700 | 90,450 | 99,866 |
| Manitoulin rural power dist. | ........ | ........ | ........ | ........ | ........ | 80 | 88 |
| Northern Ont. properties: | | | | | | | |
| Sudbury district....... | ........ | ........ | 12,935 | 10,724 | 7,574 | 12,466 | 12,466 |
| Abitibi district......... | ........ | ........ | ........ | 17,800 | 11,340 | 45,389 | 64,075 |
| Nipissing district....... | 3,170 | 3,599 | 3,745 | 3,689 | 3,751 | 3,539 | 3,840 |
| Patricia district........ | ........ | ........ | 1,582 | 1,912 | 2,048 | 2,627 | 2,828 |
| Espanola district....... | ........ | ........ | ........ | ........ | ........ | ........ | 509 |
| Total.............. | 1,028,143 | 1,133,545 | 1,300,264 | 1,107,227 | 1,108,037 | 1,366,735 | 1,451,699 |
| | December | | | | | | |
| Niagara system, 25-cycle.. | 893,231 | 969,123 | 1,073,400 | 883,200 | 838,338 | 1,134,262 | 1,150,938 |
| Dominion Power & Trans. | ........ | ........ | 61,528 | 56,166 | 48,525 | 51,743 | 54,021 |
| Eastern Ontario system... | 81,548 | 90,255 | 93,560 | 91,253 | 86,716 | 116,127 | 127,849 |
| Georgian Bay system..... | 21,595 | 22,961 | 25,591 | 27,531 | 26,424 | 25,496 | 26,816 |
| Thunder Bay system..... | 66,300 | 64,588 | 61,300 | 50,300 | 63,800 | 120,000 | 122,922 |
| Manitoulin rural power dist. | ........ | ........ | ........ | ........ | ........ | 84 | 108 |
| Northern Ont. properties: | | | | | | | |
| Sudbury district....... | ........ | ........ | 10,724 | 11,059 | 9,853 | 12,802 | 13,003 |
| Abitibi district......... | ........ | ........ | ........ | 13,000 | 13,000 | 46,890 | 93,029 |
| Nipissing district....... | 3,248 | 3,492 | 3,654 | 4,088 | 3,799 | 3,901 | 4,008 |
| Patricia district........ | ........ | ........ | 1,521 | 1,926 | 2,058 | 2,735 | 2,855 |
| Espanola district....... | ........ | ........ | ........ | ........ | ........ | ........ | 535 |
| Total.............. | 1,065,922 | 1,150,419 | 1,331,278 | 1,138,523 | 1,092,513 | 1,514,040 | 1,596,084 |

Note.—In some instances the above figures differ slightly from those appearing in the Annual Reports. Corrections have been made for the transfer of power between the Niagara and Georgian Bay systems, inclusion in the Niagara system of Gatineau resale, and, in the earlier years, using system coincident peaks instead of the sum of the district peaks for the Eastern Ontario system and showing Sudbury and Abitibi as separate districts.

all Hydro rural power districts in Ontario, who are paying standard rural rates approved for each district. It applies also to all new farm and hamlet homes which may be added to these lines as consumers during the three-year period.

*Maximum Consumption Charge*

The Commission has found that the maximum economic limit of the first domestic use throughout the Province is 6 cents per kilowatt-hour. It has been decided therefore that in all rural power districts where the first consumption rate exceeds 6 cents per kilowatt-hour, this rate will be reduced to a maximum of 6 cents per kilowatt-hour. The maximum second rate of 2 cents per kilowatt-hour applies to all districts.

*Third Consumption Rate*

During the year the Commission made available for rural consumers a special rate for long hour uses of power by rural consumers. This particularly affects under-earth heating (hot-beds) and heating of water. Where the use of power may be obtained from the

TABLE III

COMPARATIVE FINANCIAL STATEMENTS RESPECTING THE SYSTEMS OF THE COMMISSION

NIAGARA SYSTEM

| Year | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. |
| Power purchased | 378,630.25 | 1,688,516.84 | 2,644,916.07 | 3,979,524.00 | 5,513,435.12 | 6,738,406.63 | 6,872,793.14 |
| Operation, maintenance and administration | 4,551,317.95 | 4,711,607.15 | 5,606,062.59 | 5,653,006.77 | 4,893,571.40 | 4,800,173.78 | 4,821,848.99 |
| *Interest | 7,880,952.25 | 8,095,444.48 | 8,980,374.58 | 9,502,526.86 | 10,691,491.55 | 10,445,990.16 | 10,138,022.77 |
| Provision for renewals | 1,015,363.26 | 1,127,242.22 | 1,606,458.27 | 1,391,105.25 | 1,579,701.50 | 1,628,176.44 | 1,627,164.82 |
| Provision for contingencies, etc. | 2,857,495.02 | 3,117,605.94 | 2,893,784.93 | 617,820.29 | 118,462.65 | 125,698.79 | 129,514.12 |
| Sinking fund | 1,672,266.49 | 1,738,183.90 | 1,794,591.02 | 1,872,727.14 | 1,977,928.39 | 1,883,199.99 | 1,987,207.74 |
| TOTAL COST OF POWER | 18,356,025.22 | 20,428,600.53 | 23,526,187.46 | 23,016,710.31 | 24,774,590.61 | 25,621,645.79 | 25,576,551.58 |
| Less: Amount appropriated from the contingencies reserve of the system and applied in reduction of the cost of power | ........ | ........ | ........ | ........ | 2,544,648.63 | 4,236,606.73 | 2,869,828.36 |
| Net total | 18,356,025.22 | 20,428,600.53 | 23,526,187.46 | 23,016,710.31 | 22,229,941.98 | 21,385,039.06 | 22,706,723.22 |
| REVENUE from municipalities at interim rates, from rural consumers and from private customers under flat rate contracts | 19,121,214.81 | 21,664,808.55 | 24,467,322.68 | 23,752,132.85 | 22,459,448.97 | 21,096,722.06 | 22,543,780.63 |
| Net balance credited or charged to municipalities under cost contracts | 765,189.59 Credited | 1,236,208.02 Credited | 941,135.22 Credited | 735,422.54 Credited | 229,506.99 Credited | 288,317.00 Charged | 162,942.59 Charged |
| Capital investment | 161,994,023.61 | 168,004,159.13 | 199,799,252.77 | 208,501,899.28 | 207,977,388.63 | 208,143,427.49 | 208,626,540.68 |
| *Exchange included in above total of interest | ........ | ........ | ........ | ........ | 605,439.72 | 416,066.06 | 74,330.69 |

TABLE IV

COMPARATIVE FINANCIAL STATEMENTS RESPECTING THE SYSTEMS OF THE COMMISSION

GEORGIAN BAY SYSTEM

| Year | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. |
| Power purchased | 13,677.86 | 32,245.28 | 53,201.27 | 64,410.77 | 18,810.77 | 27,316.52 | 43,832.70 |
| Operation, maintenance and administration | 267,315.34 | 313,246.50 | 360,061.28 | 438,941.70 | 483,137.12 | 440,008.76 | 409,286.71 |
| *Interest | 247,283.44 | 255,110.13 | 299,428.66 | 356,655.71 | 412,557.36 | 396,690.67 | 380,745.19 |
| Provision for renewals | 72,267,13 | 78,574.72 | 92,375.30 | 121,800.88 | 124,737.66 | 128,111.66 | 129,844.11 |
| Provision for contingencies, etc. | 47,950.30 | 52 462.33 | 35,695.22 | 47,827.76 | 54,229.21 | 57,148.73 | 43,570.17 |
| Sinking fund | 55,892.24 | 59,641.34 | 69,344.10 | 83,789.13 | 86,698.15 | 87,826.94 | 88,348.64 |
| TOTAL COST OF POWER | 704,386.31 | 791,280.30 | 910,105.83 | 1,113,425.95 | 1,180,170.27 | 1,137,103.28 | 1,095,627.52 |
| REVENUE from municipalities at interim rates, from rural consumers and from private customers under flat rate contracts | 807,179.08 | 873,568.95 | 926,692.34 | 1,050,823.94 | 1,161,831.25 | 1,163,135.32 | 1,181,960.85 |
| Net balance credited or charged to municipalities under cost contracts | 102,792.77 Credited | 82,288.65 Credited | 16,586.51 Credited | 62,602.01 Charged | 18,339.02 Charged | 26,032.04 Credited | 86,333.33 Credited |
| Capital investment | 5,546,340.02 | 6,310,034.95 | 7,940,666.96 | 8,203,445.46 | 8,329,025.78 | 8,394,645 25 | 8,427,278.77 |
| *Exchanged included in above total of interest | ........ | ........ | ........ | ........ | 36,417.15 | .19,190.49 | 4,464.50 |

TABLE V

COMPARATIVE FINANCIAL STATEMENTS RESPECTING THE SYSTEMS OF THE COMMISSION

EASTERN ONTARIO SYSTEM

| Year | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. |
| Power purchased | 363,402.95 | 440,595.40 | 522,732.86 | 637,903.94 | 698,627.59 | 777.050.62 | 833,980.26 |
| Operation, maintenance and administration | 990,657.54 | 932,194.87 | 934,766.36 | 981,514.88 | 918,978.04 | 761,603.57 | 724,389.50 |
| *Interest | 783,029.18 | 810,478.17 | 913,872.57 | 938,745.56 | 968,995.87 | 894,253.67 | 913,406.78 |
| Provision for renewals | 191,653.02 | 196,129.59 | 214,924.91 | 241,193.70 | 248,330.65 | 227,793.09 | 242,903.39 |
| Provision for contingencies | 411,815.79 | 260,564.74 | 115,160.41 | 110,668.22 | 119,387.64 | 83,188.62 | 84,924.08 |
| Sinking fund | 23,612.88 | 151,030.71 | 158,835.47 | 167,272.84 | 171,432.37 | 173,029.78 | 174,813.02 |
| TOTAL COST OF POWER | 2,764,171.36 | 2,790,993.48 | 2,860,292.58 | 3,077,299.14 | 3,125,752.16 | 2,916,919.35 | 2,974,417.03 |
| Appropriated from contingencies reserve to cover shortage on operation of local distribution systems | ........ | ........ | ........ | ........ | ........ | ........ | 115.28 |
| Net total | 2,764,171.36 | 2,790,993.48 | 2,860,292.58 | 3,077,299.14 | 3,125,752.16 | 2,916,919.35 | 2,974,301.75 |
| REVENUE from municipalities at interim rates, from rural consumers and from private customers under flat rate contracts | 3,054,260.20 | 3,025,908.37 | 3,051,987.02 | 3,232,921.80 | 3,199,177.07 | 2,920,450.19 | 3,084,008.59 |
| Excess revenue over cost of power | 291,088.84 | 234,914.89 | 191,694.44 | 155,622.66 | 73,424.91 | 3,530.84 | 109,706.84 |
| Profit from sale of power to companies and/or local distribution systems, transferred to contingencies reserve | 218,962.33 | 148,980.44 | 117,244.91 | 136,927.20 | 48,122.89 | 1,281.64 | ........ |
| Net balance credited to municipalities under cost contracts | 71,126.51 | 85,934.45 | 74,449.53 | 18,695.46 | 25,302.02 | 2,249.20 | 109,706.84 |
| Capital investment | 19,446,757.26 | 20,447,230.08 | 20,917,182.90 | 21,570,767.11 | 21,060,823.96 | 19,372,833.44 | 19,851,622.12 |
| *Exchange included in above total of interest | ........ | ........ | ........ | ........ | 41,389.17 | 48,908.42 | 62,461.30 |

TABLE VI

COMPARATIVE FINANCIAL STATEMENTS RESPECTING THE SYSTEMS OF THE COMMISSION

THUNDER BAY SYSTEM

| Year | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 |
|---|---|---|---|---|---|---|---|
| | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. |
| Power purchased | ........ | 3,161.50 | 474.00 | ........ | ........ | ........ | ........ |
| Operation, maintenance and administration | 143,353.98 | 191,903.99 | 225,693.87 | 217,397.15 | 203,224.26 | 214,729.82 | 215,991.04 |
| *Interest | 651,827.79 | 662,675.66 | 655,340.84 | 879,477.46 | 1,017,730.35 | 972,869.43 | 912,622.62 |
| Provision for renewals | 109,106.32 | 109,200.41 | 112,798.56 | 151,173.65 | 147,471.19 | 149,518.82 | 160,490.28 |
| Provision for contingencies, etc. | 107,636.54 | 332,981.76 | 346,252.43 | ........ | 132.36 | 869.29 | 1,140.37 |
| Sinking fund | 131,552.72 | 132,343.09 | 137,011.32 | 135,813.13 | 137,066.04 | 140,993.98 | 148,323.24 |
| TOTAL COST OF POWER | 1,143,477.35 | 1,432,266.41 | 1,477,571.02 | 1,383,861.39 | 1,505,624.20 | 1,478,981.34 | 1,438,567.55 |
| Amount appropriated from contingencies reserve of the system and applied in reduction of the cost of power | ........ | ........ | ........ | ........ | 143,499.15 | 41,359.65 | ........ |
| Net total | 1,143,477.35 | 1,432,266.41 | 1,477,571.02 | 1,383,861.39 | 1,362,125.05 | 1,437,621.69 | 1,438,567.55 |
| REVENUE from municipalities at interim rates, from rural consumers and from private customers under flat rate contracts | 1,145,031.55 | 1,454,080.66 | 1,481,978.47 | 1,339,046.63 | 1,235,438.17 | 1,380,099.79 | 1,383,066.52 |
| Net balance credited or charged to municipalities under cost contracts | 1,554.20 Credited | 21,814.25 Credited | 4,407.45 Credited | 44,814.76 Charged | 126,686.88 Charged | 57,521.90 Charged | 55,501.03 Charged |
| Capital investment | 14,332,937.23 | 15,325,411.00 | 17,645,796.31 | 18,406,363.39 | 18,480,738.51 | 18,630,772.18 | 18,679,610.73 |
| *Exchange included in above total of interest | ........ | ........ | ........ | ........ | 100,968.00 | 58,865.89 | ........ |

present equipment, a third follow-up rate of 0.75 cents gross is given in all districts. The first rate remains unchanged, except that, as pointed out above, it is subject to a maximum of 6 cents per kilowatt-hour, and the kilowatt-hours to be charged at the first rate remain unchanged. The number of kilowatt-hours to be charged at the second rate varies both with the class of service and the first kilowatt-hour rate. The following is the schedule (Table VII). It shows the class of service, the number of kilowatt-hours per month to be charged for at the first rate, and the number of kilowatt-hours at the second rate according to the governing first rate.

It is estimated that the total saving to rural consumers on account of giving free power for the three uses above set out will amount to approximately $64,000 per year.

It is estimated that the reduction of the first consumption rate to a maximum of 6 cents per kilowatt-hour will mean a saving of approximately $6,400 per year to the rural consumers so affected.

Based on consumption figures for 1934, it is estimated that the rate reduction involving a new third rate of 0.75 cents will reduce the existing accounts of rural consumers throughout the Province by an amount of approximately $30,000 per year.

### Water Heaters

During the period November 1, 1933, to October 31, 1934, there were installed 7,848 water heaters, having an average capacity of 600 watts per heater. The total load is, therefore, 4,708.8 kilowatts, or 6,310 horsepower. There were also approximately 900 booster water heaters installed, having an average capacity of 2 kilowatts, or a total capacity of 1,800 kilowatts, or 2,400 horsepower. The estimated annual consumption for booster and flat rate water heaters is 43,000,000 kilowatt-hours.

### Electric Ranges

It is estimated that during the year 1934, 3,000 electric ranges were installed. These ranges have an average demand of 1 horsepower per range, and it is estimated that the annual

TABLE VII

SCHEDULE—FOR EACH CLASS OF RURAL SERVICE—OF KILOWATT-HOURS PER MONTH TO BE CHARGED FOR AT THE FIRST CONSUMPTION RATE AND AT THE SECOND CONSUMPTION RATE

All kilowatt-hours in excess of the sum at the first and second rates to be billed at 0.75 cents per kilowatt-hour

| Class of rural service | Number of kw-hrs. per month at first energy rate | Number of kw-hrs. per month at second energy rate — Where first energy rate in district is: more than 5 cents | 4.1 cents to 5 cents | 3.1 cents to 4 cents | 3 cents | less than 3 cents |
|---|---|---|---|---|---|---|
| 1B | 30 | 45 | 60 | 75 | 105 | 120 |
| 1C | 30 | 120 | 150 | 180 | 240 | 270 |
| 2A | 30 | 45 | 60 | 75 | 105 | 120 |
| 2B | 30 | 120 | 150 | 180 | 240 | 270 |
| 3 | 42 | 108 | 138 | 168 | 228 | 258 |
| 4 | 70 | 180 | 230 | 280 | 380 | 430 |
| 5 | 70 | 180 | 230 | 280 | 380 | 430 |
| 6 | 126 | 324 | 414 | 504 | 684 | 774 |
| 7 | 210 | 540 | 690 | 840 | 1140 | 1290 |

consumption on these additional ranges amounts to 7,200,000 kilowatt-hours.

### Steam Electric Boilers

In the process of paper-making—one of the most important industries of the Province—much coal-produced steam has been utilized heretofore in drying the paper as it passed over large steam cylinders before being assembled in rolls for shipment. When a serious over-supply of power began to come into the various systems—chiefly the Niagara—arrangements were made for the resale of some part of this surplus to the Gatineau Company at a price competitive with coal for the production of steam by electrically heated boilers. Other paper mills, extending across the Province from Cornwall to Thunder Bay, have become customers for steam-electric power In most cases the plant utilized in steam production is installed by the Hydro-Electric Power Commission, and remains the property of the Commission. The revenue from this utilization of surplus power, which would otherwise have remained unused, was $809,386 during the year under review. The quantity used, total revenue, and rate obtained, were as follows (Table VIII).

### Constructional Activities

The basis of constructional activity on new hydraulic plants and extensions has been the increase in the value of gold per ounce throughout the civilized world. This has brought about the mining of quantities of marginal ore in developed mines and the opening up of many mines that could not have been operated when gold was worth $20.00 an ounce. The estimated tonnage of some of these new mines in process of development indicates a rapidly growing field for the sale of electric energy throughout Northern Ontario. The Commission is in a position to supply that energy on favourable terms because of the acquisition by the Government of the Abitibi Canyon plant.

The installation of the second 48,500-kv-a. generator at the Abitibi Canyon development has been completed, and three 110,000-volt transformer stations have been built in Northern Ontario. At Kirkland Lake a 28,500-kv-a. transformer station has been installed to supply power to the Canada Northern Power Corporation, and a 4,500-kv-a. transformer station in Powell Township for a power supply to the Matachewan area. A third transformer station, having a capacity of 39,000 kv-a., and two 25,000-kw. electric steam generators have been installed at the Abitibi Power and Paper Company's plant at Smooth Rock Falls, to supply the Company with secondary power for the generation of steam. Nearly one hundred miles of 132,000-volt transmission lines have been constructed to transmit power from the Abitibi Canyon development to customers in the district.

### Rat Rapids Development

A small hydro-electric development is under construction at Rat Rapids, at the outlet of lake St. Joseph, and is designed to supply power to mining developments north of the lake in the District of Patricia. This power plant is seven hundred and thirty miles as the crow flies from Toronto, and in that great area north-west of lake Superior to the Manitoba boundary, it is probable that a number of similar small plants will have to be located. The cost of these plants will be returned by amortization carried for periods so short as to be well within the life of the mines they are called into existence to serve.

All the developments in the region of the Province lying to the north and west of the line of the French river and lake Nipissing, except those of the Thunder Bay system, are the property of the Province, and are operated by this Commission as agent of the Government. Any losses sus-

TABLE VIII

POWER SOLD FOR STEAM GENERATION—NOVEMBER 1, 1933 TO OCTOBER 31, 1934

| System and customer | Contract amount | Total energy delivered | Total revenue | Rate |
|---|---|---|---|---|
| | horsepower | kw-hrs. | $ c. | mills |
| *Niagara system* | | | | |
| Canadian International Paper Company | 45 000 to | 348,993,867 | 244,295.69 | 0.7 |
| (Gatineau Power Company).......... | 55,000 | 126,526,000 | 94,894.50 | 0.75 |
| | | 475,519,867 | 339,190.19 | |
| Interlake Tissue Mills Company Limited | 10,724 | 19,799,023 | 14,849.27 | 0.75 |
| Norton Co.......................... | 800 | 1,863,840 | 3,727.63 | 2.0 |
| Ontario Paper Co.................... | 93,834 | 424,315,089 | 212,157.52 | 0.5 |
| Provincial Paper Limited............... | 11,394 | 24,659,635 | 18,494.71 | 0.75 |
| Total Niagara system............. | ............ | 946,157,454 | 588,419.32 | |
| *Eastern Ontario System* | | | | |
| Howard Smith Paper Mills Limited..... | 13,405 | 28,249,500 | 14,124.75 | 0.5 |
| Canadian International Paper Company (Gatineau Power Company) | ............ | 40,916,300 | 28,641.41 | 0.7 |
| Total Eastern Ontario system...... | ............ | 69,165,800 | 42,766.16 | |
| *Thunder Bay System* | | | | |
| National Trust Company.............. (Great Lakes Paper Company) | 20,107 | 52,456,000 | 26,228.00 | 0.5 |
| Provincial Paper Limited.............. | 32,131 | 130,975,000 | 72,036.25 | 0.55 |
| Thunder Bay Paper Company (Approx.). | 8,000 | 24,169,714 | 12,084.85 | 0.5 |
| Total Thunder Bay system........ | ............ | 207,600,714 | 110,349.10 | |
| *Northern Ontario Properties* | | | | |
| Abitibi Power & Paper Company....... (Iroquois Falls) | 32,131 | 82,640,800 | 53,716.52 | 0.65 |
| Abitibi Power & Paper Company....... (Smooth Rock Falls) | 52,279 | 19,220,000<br>373,000 | 14,415.00<br>279.75 | 0.75 |
| Less reduction by 50% of the cost of power used during the initial testing period, Aug. 1-5, 1934............... | | 18,847,000 | 14,135.25 | |
| Total Northern Ontario properties.. | ............ | 101,487,800 | 67,851.77 | ........ |
| Total All Systems................ | ............ | 1,324,411,768 | 809,386.35 | ........ |

tained in operation heretofore have been recouped from the provincial treasury; profits which may accrue hereafter will become revenue of the provincial treasury.

The Commission, as agent of the Department of Lands and Forests of Ontario, also carried through certain navigation improvements on the Root river, comprising three marine railways, channel improvements, and about three and a half miles of standard gauge railway.

At the Howard Smith Paper Mills at Cornwall a 20,000-kv-a. transformer station and a 20,000-kw. electric steam generator have been installed and placed in operation. A transmission line was built from Ottawa to the Cornwall transformer station to provide a suitable power supply, at the latter point, on the

termination of the supply from the Cedar Rapids Transmission Company.

### New Rural Consumers

About one hundred and ninety miles of primary rural lines have been constructed and over eighteen hundred new consumers have been supplied with power during the year.

A contract was let for, and construction is well under way on, an addition to the present administration building on University avenue.

### Operating Conditions

The operation of the various systems has measured up to the customary standard of the Commission; in spite of the severe weather conditions during the winter of 1933-34, interruptions were relatively few. Equipment failures of sufficient importance to mention were confined to the armature windings of generators No. 2 and No. 5 at the Ontario Power plant, and No. 2 synchronous condenser at Leaside.

Generating capacity was somewhat reduced on the Georgian Bay system and at Chats Falls due to low stream flow. On the Georgian Bay system the resulting lack of energy was offset by the transfer of power from Niagara system through the Hanover frequency-changer station.

Due to sub-normal precipitation and the lowering of Wanapitei Lake for mining interests, some difficulty was experienced in maintaining sufficient stream flow in the Wanapitei river for the Commission's plants, and it was necessary to remove by blasting some obstructions above the Wanapitei dam. By the end of the fiscal year conditions had improved, and the storage basins were replenished. On all other systems water conditions were satisfactory.

### Financial Summaries

The financial statements embodied in this Report are presented in two main divisions, namely, a division—Section IX—which deals chiefly with the operations of the Commission in the generation, transformation and transmission of electrical energy to the co-operating municipalities and to certain large industries; and a division — Section X — which deals with the various operations of the municipal electric utilities in the localized distribution of electrical energy to consumers. In Section IX, "Rural Operating" reports are also given, which summarize the results of the local distribution of rural electrical service by the Commission to the individual consumers in rural power districts. This work is performed by the Commission on behalf of the respective townships co-operating to provide rural service.

### Capital Investment

The total investment of the Hydro-Electric Power Commission of Ontario in power undertakings and hydro-electric railways is \$287,387,957.03, exclusive of government grants in respect of construction of rural power districts' lines; and the investment of the municipalities in distributing systems and other assets is \$110,836,805.08, making in power and hydro-electric railway undertakings a total investment of \$398,224,762.11.

The following statement (Table IX) shows the capital invested in the respective systems, districts and municipal undertakings.

The total reserves of the Commission and the municipal electric utilities for sinking fund, renewals, contingencies and insurance purposes amount to \$138,392,201.38, made up as follows (Table X).

The total reserves of the Commission increased in 1934 by \$4,781,533.55 over the total for 1933, which was \$69,433,260.25. The net increase in total reserves was, in 1934, less than in some former years.

The consolidated balance sheet of the municipal electric utilities, on page 284, shows a total cash balance of \$2,215,914.31, and bonds and other

TABLE IX

| | |
|---|---|
| Niagara system | $208,626,540.68 |
| Georgian Bay system | 8,427,278.77 |
| Eastern Ontario system | 19,851,622.12 |
| Thunder Bay system | 18,679,610.73 |
| Manitoulin rural power district | 35,472.86 |
| Nipissing rural power districts | 22,751.21 |
| Northern Ontario properties | 25,121,103.24 |
| Hydro-Electric railways | 2,173,663.59 |
| Office and service buildings, construction plant, inventories, etc. | 4,449,913.83 |
| | $287,387,957.03 |
| Municipalities' distribution systems—all systems | 91,675,564.93 |
| Other assets of municipal Hydro utilities (exclusive of $29,274,340.46 of municipal sinking-fund equity in H-E.P.C. system)—all systems | 19,161,340.15 |
| | $398,224,762.11 |

investments of $2,382,446.41. The total surplus in the municipal books now amounts to $44,744,584.69, in addition to depreciation and sundry other reserves aggregating $19,432,822.89; these two amounts making the total of $64,177,407.58 shown in the above table. The net increase in the municipal utilities' local reserves and surplus was $4,440,587.82 and the net increase in the total of Commission and municipal reserves for the year was $9,222,121.37. The increase of reserves since October 31, 1924, has been $99,351,663.06.

### Revenue of Commission

The revenue of the Commission at interim rates from the municipal utilities operating under cost contracts, from customers in rural power districts and from other customers with whom—on behalf of the municipalities—the Commission has special contracts, all within the Niagara, Georgian Bay, Eastern Ontario and Thunder Bay systems, Manitoulin Island and Nipissing rural power districts aggregates $28,213,252.72. The revenue of the Commission from customers served by the Northern Ontario properties, which are held and operated in trust for the Province, is $1,238,311.00, making a total of $29,451,563.72.

Summarized operating results of these systems and rural power districts, and of the Northern Ontario properties, follow (Table XI).

### Rural Electrical Service

There is now rather more than $18,300,000 invested in the rural power district systems established by the Commission. Towards this rural work the Ontario Government, pursuant to its policy of promoting the basic industry of agriculture, has, in

TABLE X

| | |
|---|---|
| Niagara system | $55,092,547.51 |
| Georgian Bay system | 3,153,898.87 |
| Eastern Ontario system | 5.984,350.35 |
| Thunder Bay system | 3,521,436.40 |
| Manitoulin rural power district and Nipissing rural power districts | 12,714.03 |
| Northern Ontario properties | 868,608.88 |
| Office and service buildings and equipment | 750,935.63 |
| Bonnechere storage | 5,417.39 |
| Total reserves in respect of Commission's properties | $69,389,909.06 |
| Hydro-Electric railways (Guelph) | 134,722.21 |
| Insurance, workmen's compensation and staff pensions | 4,690,162.53 |
| Total reserves of the Commission | $74,214,793.80 |
| Total reserves and surplus of municipal electric utilities | 64,177,407.58 |
| Total Commission and municipal reserves | $138,392,201.38 |

TABLE XI

SYSTEMS OF THE COMMISSION

| | | |
|---|---|---|
| Revenue from municipal electric utilities and other power customers | $25,380,581.20 | |
| Revenue from customers in rural power districts | 2,832,671.52 | |
| Total revenue, systems and rural | | $28,213,252.72 |
| Operation, maintenance, administration, interest and other current expenses | $26,283,475.40 | |
| Reserves for sinking fund, renewals, contingencies and obsolescence provided in the year | 4,823,318.99 | |
| Total expenses and reserves | $31,106,794.39 | |
| Less: Appropriated from contingencies reserve | 2,869,943.64 | |
| Net total | | 28,236,850.75 |
| Net balance charged to municipalities under cost contracts | | $ 23,598.03 |

NORTHERN ONTARIO PROPERTIES

| | | |
|---|---|---|
| Revenue from customers | | $ 1,238,311.00 |
| Operation, maintenance, administration, interest and other current expenses | $1,355,756.05 | |
| Reserves for renewals and contingencies | 220,309.02 | |
| Total expenses and reserves | | 1,576,065.07 |
| Balance, which is charged to Province of Ontario, subject to repayment out of any future surplus earnings of the properties | | $ 337,754.07 |

the form of grants-in-aid, contributed 50 per cent. of the costs of transmission lines and equipment, or some $9,000,000.

Segregated from the summary of the Commission's operating revenues as a whole, which has been presented above, the data relating to rural power districts show in the aggregate a revenue from rural customers of $2,832,671.52 which was $76,295.20 less than the total cost, including reserve requirements computed at the customary rates.

## Municipal Electric Utilities

The following is a summation of the year's operation of the local electric utilities conducted by municipalities receiving power under cost contracts with the Commission ( able XIII).

The following statements respecting the several systems and the Northern Ontario properties summarize the financial features of their operation. The municipalities included in each system, the territories served by each system, and the power supplies provided for each system, are shown on the map at the end of the Report and in tabular statements in the body of the Report.

## Niagara System

The total capital invested by the Commission on behalf of the co-operating municipalities of the Niagara system amounts to $208,626,540.68. This amount includes the investment in the power properties purchased from the Dominion Power and Transmission Company (which have been merged with, and now form part of the Niagara system), also the Commission's share of the generating plant at Chats Falls, together with the transformer and switching stations at that point and the transmission lines from the Ottawa river to the Niagara system. The accumulated reserves for renewals, obsolescence, contingencies and sinking fund, aggregate $55,092,547.51.

From customers in the rural power districts of this system the revenue received by the Commission for the year was $2,080,385.53, and the total cost of supplying service was $2,120,-

TABLE XII

RURAL POWER DISTRICTS—OPERATIONS FOR THE YEAR 1934

| | Niagara system | Georgian Bay system | Eastern Ontario system | Thunder Bay system | Manitoulin rural power district | Nipissing rural power districts | Totals |
|---|---|---|---|---|---|---|---|
| | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. | $ c. |
| Cost of power as provided to be paid under Power Commission Act....... | 831,512.85 | 102,384.33 | 183,714.46 | 3,177.88 | 3,750.00 | 4,399.67 | 1,128,939.19 |
| Cost of operation, maintenance and administration.. | 529,535.07 | 58,267.17 | 122,170.71 | 3,531.59 | 2,313.61 | 2,013.95 | 717,832.10 |
| Interest.......... | 301,774.53 | 36,986.15 | 82,273.43 | 2,818.50 | 1,888.53 | 998.33 | 426,739.47 |
| Renewals........ | 259,028.24 | 30,557.10 | 65,611.42 | 2,280.75 | 1,288.67 | 840.14 | 359,606.32 |
| Obsolescence and contingencies... | 129,514.12 | 15,278.55 | 32,805.71 | 1,140.37 | 644.33 | 420.07 | 179,803.15 |
| Sinking fund..... | 68,856.46 | 8,450.52 | 17,540.50 | 600.41 | 373.52 | 225.08 | 96,046.49 |
| Total expenses.... | 2,120,221.27 | 251,923.82 | 504,116.23 | 13,549.50 | 10,258.66 | 8,897.24 | 2,908,966.72 |
| Revenue from customers...... | 2,080,385.53 | 242,562.04 | 479,968.71 | 11,793.92 | 8,235.38 | 9,725.94 | 2,832,671.52 |
| Balances credited to districts or charged to municipalities comprising districts: | | | | | | | |
| Net credit, all districts....... | ........ | ........ | ........ | ........ | ........ | 828.70 | 828.70 |
| Net charge, all districts........ | 39,835.74 | 9,361.78 | 24,147.52 | 1,755.58 | 2,023.28 | ........ | 77,123.90 |
| Net charge, all systems........ | ........ | ........ | ........ | ........ | ........ | ........ | 76,295.20 |

221.27, leaving a balance of $39,835.74, which has been charged to the rural power districts of this system.

With respect to the electric utilities of the various urban municipalities of the Niagara system served under cost contracts, the cost of power as adjusted by the Commission at the close of the year was $123,106.85 more than the total amount collected at the interim rates and this sum has been charged to the municipal utilities.

The total revenue of the municipal electric utilities served by this system was $26,191,701.88, an increase of $1,167,263.19 as compared with the previous year. After meeting all expenses in respect of operation,

TABLE XIII

| | | |
|---|---|---|
| Total revenue collected by the municipal electric utilities.................. | | $31,970,390.08 |
| Cost of power........................................ | $19,591,887.79 | |
| Operation, maintenance and administration.................. | 5,093,212.46 | |
| Interest.......................................... | 2,204,994.25 | |
| Sinking fund and principal payments on debentures.......... | 2,358,169.12 | |
| Depreciation and other reserves........................ | 2,036,637.33 | |
| Total.............................................. | | 31,284,900.95 |
| Surplus.............................................. | | $ 685,489.13 |

including interest, setting up the standard depreciation reserve amounting to $1,655,012.39, and providing $2,161,666.45 for the retirement of instalment and sinking fund debentures, the total net surplus for the year for the municipal electric utilities served by the Niagara system amounted to $239,441.59.

### Georgian Bay System

The total capital invested by the Commission on behalf of the co-operating municipalities of the Georgian Bay system amounts to $8,427,278.77. The accumulated reserves for renewals, obsolescence, contingencies and sinking fund aggregate $3,153,898.87.

From customers in the rural power districts of this system the revenue received by the Commission for the year was $242,562.04, and the total cost of supplying service was $251,923.82, leaving a balance of $9,361.78, which has been charged to the rural power districts of this system.

With respect to the electric utilities of the various urban municipalities of the Georgian Bay system served under cost contracts, the cost of power supplied by the Commission during the year was $95,695.11 less than the total amount collected at the interim rates and this sum has been credited to the municipal utilities.

The total revenue of the municipal electric utilities served by this system was $1,169,921.21, an increase of $34,665.86 as compared with the previous year. After meeting all expenses in respect of operation, including interest, setting up the standard depreciation reserve amounting to $74,603.00, and providing $54,745.02 for the retirement of instalment and sinking fund debentures, the total net surplus for the year for the municipal electric utilities served by the Georgian Bay system amounted to $86,378.01.

### Eastern Ontario System

The total capital invested by the Commission on behalf of the co-operating municipalities of the Eastern Ontario system amounts to $19,851,622.12. The accumulated reserves for renewals, obsolescence, contingencies and sinking fund aggregate $5,984,350.35.

From customers in the rural power districts of this system the revenue received by the Commission for the year was $479,968.71, and the total cost of supplying service was $504,116.23, leaving a balance of $24,147.52, which has been charged to the rural power districts of this system.

With respect to the electric utilities of the various urban municipalities of the Eastern Ontario system served under cost contracts, the cost of power supplied by the Commission during the year was $133,854.36 less than the total amount collected at the interim rates and this sum has been credited to the municipal utilities.

The total revenue of the municipal electric utilities served by this system was $3,308,659.41, an increase of $165,809.26 as compared with the previous year. After meeting all expenses in respect of operation, including interest, setting up the standard depreciation reserve amounting to $184,205.05, and providing $125,546.87 for the retirement of instalment and sinking fund debentures, the total net surplus for the year for the municipal electric utilities served by the Eastern Ontario system amounted to $294,876.54.

### Thunder Bay System

The total capital invested by the Commission on behalf of the co-operating municipalities of the Thunder Bay system amounts to $18,679,610.73. The accumulated reserves for renewals, obsolescence, contingencies and sinking fund aggregate $3,521,436.40.

From customers in the rural power districts of this system the revenue received by the Commission for the year was $11,793.92, and the total

cost of supplying service was $13,-549.50, leaving a balance of $1,755.58, which has been charged to the rural power districts of this system.

With respect to the electric utilities of the various urban municipalities of the Thunder Bay system served under cost contracts, the cost of power supplied by the Commission during the year was $53,745.45 more than the total amount collected at the interim rates and this sum has been charged to the municipal utilities.

The total revenue of the municipal electric utilities served by this system was $1,300,107.58, a decrease of $25,190.11 as compared with the previous year. After meeting all expenses in respect of operation, including interest, setting up the standard depreciation reserve amounting to $39,804.75, and providing $16,210.78 for the retirement of instalment and sinking fund debentures, the total net surplus for the year for the municipal electric utilities served by the Thunder Bay system amounted to $64,792.99.

### Northern Ontario Properties

In accordance with the agreement under which the Commission holds and operates the Northern Ontario properties in trust, for the Province, the properties are for purpose of financial administration treated as one unit. The total capital invested by the Commission on behalf of the Province in the Northern Ontario properties is $25,121,103.24, and the accumulated reserves for renewals, obsolescence and contingencies aggregate $868,608.88.

The costs of operation for the year, including interest and the sum of $220,309.02 set aside to renewals and contingencies reserves, were $1,576,-065.07. The costs exceeded the revenues from customers supplied with power from the Northern Ontario properties, by $337,754.07, which amount, in accordance with the governing agreement, is charged to the Province, subject to repayment out of any future surplus earnings of the properties.

### The Annual Report

The Table of Contents, pages xxv and xxvi, conveys a good understanding of the scope of the matters dealt with in the Report, to which there is also a comprehensive Index. To those not conversant with the Commission's Reports the following notes will be useful.

In Section II, pages 5 to 57, dealing with the Operation of the Systems, are a number of interesting diagrams showing, graphically, the monthly loads on the several systems and districts. Tables are also presented showing the amounts of power taken by the various municipalities in October during the past three years.

The rural distribution work of the Commission has proved of widespread interest and special reference to this is made in Section III, on pages 65 to 84. The power distributed to rural districts is, and possibly must always be, but a relatively small proportion of the power distributed by the Commission. The supplying of electrical service in rural areas, and especially on the farm, has, however, been of great economic benefit to Ontario. The Provincial Government grants-in-aid of the capital cost of this work have been of value to agricultural activities, and have assisted the Commission to extend rural transmission lines to many areas.

In Sections IV, V and VI will be found information respecting progress of work on new power developments and on transmission system extensions, together with photographic illustrations.

About one-half of the Report is devoted to financial and other statistical data which are presented in two Sections IX and X.

Section IX presents in summary form the financial statements relating to the operations of the Commission chiefly in the generation, transformation and transmission of electrical

energy to the co-operating municipalities. It is introduced by an important explanatory statement which appears on pages 133 to 137, to which special reference should be made.

Section X presents in summary form the financial statements relating to the operations of the municipalities in the localized distribution of electrical energy to consumers. It also contains details of the costs of electrical energy to consumers in the various municipalities and tabular statements of the rates in force which have produced these costs. An explanation of the various tables and statements is given at the commencement of this Section on pages 277 to 279, and a special introduction to Statement "D", which relates to the cost of electrical service in Ontario, together with a diagram, appears on pages 402 to 405.

In its Annual Reports the Commission aims to present a comprehensive statement respecting the activities of the whole undertaking under its administration. Explanatory statements are suitably placed throughout the Report. The Commission receives many letters asking for general information respecting its activities, as well as requests for specific information concerning certain phases of its operations. In most cases these enquiries can satisfactorily be answered by simply directing attention to information presented in the Annual Report of the Commission.

* * * *

During the year of which this summary is a record, the personnel of the Commission has been entirely changed. When the year began on 1st November, 1933, the Commissioners were Honourable J. R. Cooke (Chairman), Mr. C. Alfred Maguire (Vice-Chairman), and Right Honourable Arthur Meighen. Mr. Meighen resigned on May 18, 1934, and by Order-in-Council, dated July 11, 1934, the other two members of the Commission were retired from office, Mr. T. Stewart Lyon (Chairman), Honourable Arthur W. Roebuck and Honourable T. B. McQuesten being appointed in their stead, the latter two serving without salary.

Extensive changes have been made in the personnel of the chief officials of the Commission, among those retired were Mr. F. A. Gaby, chief engineer, Honourable I. B. Lucas, general solicitor, Mr. A. V. White, consulting engineer and Mr. E. A. Hugill, head of the Right-of-Way department. Mr. J. W. Gilmour, treasurer, retired on pension immediately before the present Commission assumed office, and Mr. John Littlejohn retired on pension shortly after the present Commission assumed office. Mr. Littlejohn had charge of the Insurance department of the Commission. The position of treasurer has not been filled. Mr. T. K. Jones, formerly assistant-treasurer, is now acting-treasurer. The duties of Mr. Gaby have been divided, for the most part, between Dr. T. H. Hogg, who has become engineer in charge of construction and operation, and Mr. R. T. Jeffery, who is in charge of municipal relations and power sales.

At the close of the fiscal year further changes in staff were pending, which it was believed would still further reduce the administrative cost, without any lessening of efficiency. Most of the officials slated for retirement have reached the age of 60 years and were entitled to retiring allowances under the system of contributory pensions, which has been in operation since 1923. It is the opinion of the undersigned that these changes have promoted rather than retarded the spirit of goodwill and co-operation that must exist in an organization so complicated and so large as that of the Hydro-Electric Power Commission of Ontario, if the best possible service is to be rendered by the members of the staff.

There is evidence that in their dealings with the local power commissions,

with private consumers of energy and with the public generally, the members of the staff in all departments have a firm grasp of the basic principle underlying the operations of the Commission, that of providing light and power at cost to all sections of the people of the Province. There will always be consumers with grievances to present to the officials and to the Commission for redress. Assurance can be given that such grievances will not be treated cavalierly, but will be enquired into, without prejudice, and settled with a desire to do justice in every case.

Since the closing of the books of the Commission for the year ending October 31, 1934, there has been a continuing increase in the power sales of the Commission. It has not been so great as the optimistic prophets of former years believed it would be, but it has shown a steady upward curve. This has been true especially in Northern Ontario, where much of the increase in the output of gold mining companies has been due to the provision made by the Commission for the sale of power at prices materially below those obtaining before the Commission entered the field in competition for gold mining power loads.

Respectfully submitted,

T. STEWART LYON,
*Chairman*

# In Return for My Electric Bill

THE following is taken from one of a series of talks on "Some Practical Applications of Electricity in Farming" prepared under the auspices of the Rural Electrification Section of the General Electric Company. The author is Mrs. John D. Pitts, farmer, Rhinebeck, N.Y., who outlines many of the uses to which electricity may be put in the farm home and the resultant convenience and saving in labour and the improvement in the home atmosphere. There are still many urban households in which Mrs. Pitt's example could be copied.

At the press of a button or the turn of a switch, we have instantaneous light, day and night—which is not only absolutely safe, but also saves many hours of labour each month cleaning oil lamps and chimneys.

Our furnace is dependent on a little electric motor for automatic operation. It furnished our heat free from smoke, soot and dirt and saves the labour of shovelling coal and ashes. My cellar makes an ideal playroom for the children on a rainy day.

The electric automatic water heater furnishes an abundance of hot water continuously for bath and kitchen at an even temperature.

We also receive perfect refrigeration with our electric refrigerator, which has been in use in my home for several years and has long since saved its original cost, by enabling me to buy in larger quantities, thus saving money on the food budget. If one forms the habit of keeping the special things in the electric refrigerator, any meal may be a company meal, especially with the many delicious frozen desserts which may be so easily and quickly prepared.

I also use daily a vacuum cleaner, radio, electric clocks, and other small appliances.

And last my range which cooks us three square meals a day. The cost of operating a range depends on the person who operates it. For example, when I bake, I usually start with pie and cake following with biscuits and some sort of roast meat and baked potatoes. It takes but little more electricity to bake all this than it would be for just one article.

The broiler is wonderful for steaks, chops, bacon and fish. I never fry any of these for they have an entirely different flavour when broiled.

The coffee I put in the percolator the last thing at night and set the clock for the hour I want to get up in the morning. The alarm awakens me and throws the switch which starts the coffee which is finished by the time I reach the kitchen.

I also have an electric sewing machine that saves me much time and money, and I have an iron which I use for pressing.

My son finds studying at home much easier in the evening with the aid of the new student lamps, and I know they are saving his eyes from strain.

Of course, one of the greatest things which we have in our home is only indirectly connected with our electric bill. This is my kitchen which we have remodeled completely. It looks quite different now—no coal range; no kerosene stove; no more smoked up walls and ceiling; no hot water boiler, and what a saving in steps and labour. The many hours I spend there during a year are pleasant and much less tiring than in the so-called good old days.

Taken all together, I am sure my many electric servants have cut my working hours in half. I think you'll agree with me that we surely get a lot in the way of comfort, convenience, and labour-saving

# The Trend Toward Outdoor Metering

**By G. A. Sawin, Asst. Sales Manager, Central Station Division, Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.**

*(From a paper presented to Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, July 4, 1935.)*

MY paper today deals with the art of measuring the electrical energy delivered by you to your customers.

I think our present needs can be grouped under three classifications—

1. Insure Accurate Measurement.

To do this, you should see that every meter on your system is measuring the energy delivered in the most accurate manner; that is, accurate over wide ranges of load, and wide variations in temperature.

2. Decrease Maintenance Expense.

Maintenance items amount to an appreciable figure of expense including installing and removing meters, testing and reading.

3. Protect Your Revenue.

By this I mean, make your installation such that you eliminate what is politely called "diversion of energy".

Let us elaborate a little on these points.

## 1. Insure Accurate Measurement

The accuracy of present day meters under wide variations of load from very light loads up to 300 per cent. load is exceptionally good. Improvements in overload accuracy came into effect in 1924, when a decided improvement was made over previous types of meters. Since 1924, additional improvements have been made, until to-day the modern meter at 300 per cent. load will not be over 1 per cent. slow as compared to meters built before 1924, which would run from 8 per cent. to 10 per cent. slow at this same load.

It is only in recent years that meters have been compensated for changes in temperature. Older types of meters varied considerably in this respect and would run about 1 per cent. slower for every 20 deg. fahr. drop in temperature. However, modern meters will show practically no error from minus 30 deg. fahr. to 120 deg. fahr. Therefore, to insure accuracy, meters older than these types mentioned should be either scrapped or rebuilt to bring them up to modern standard in these two respects. The rate of scrapping or rebuilding should, of course, depend upon the actual conditions of your particular system. However, a study of your conditions, and a planned system of rebuilding, should be on the program of each public utility. It is true economy to spend money to save more money.

## 2. Decrease Maintenance Expense

This covers all the various maintenance items and they are not small. An opportunity is afforded here to save a considerable amount of money. Probably the first and most important possibility for saving comes in placing

the meter out-of-doors, thus assuring that your meter is accessible at all times. I do not need to point out to you Gentlemen, that a large part of your maintenance expense is the time now wasted in getting permission to enter the premises where the meter is installed. This wasted time occurs whether you are installing, removing, testing or reading the meter. The getting into premises slows up your maintenance work on each and every occasion. Take reading alone—it has been estimated that 50 to 100 more readings could be taken per day on outdoor meters as compared to indoor. Also there are no missed readings when the meters are out-of-door. It has been estimated that missed readings amount to 10 to 20 per cent. of the total readings with return trips necessary, at very high costs. In addition, if meters are out-of-doors, there is no necessity for bothering or annoying the customer at each reading period in order to take care of what is your business, not his. Cordial public relations are, therefore, encouraged. Many missed readings are due to the housewife not answering the door bell for fear of peddlers or beggars. Outdoor meters will eliminate all these troubles.

One of the expensive maintenance problems is the periodic testing of meters. In Canada, I understand testing in place is not general, but instead, meters are removed to the test room when the Government sealing date approaches. In this work there is a great opportunity for decreasing your expenses by placing the meter out-of-doors. In addition, with the detachable type the ease in removing and installing offers a further possibility of saving as compared with the conventional meter. Therefore, if you place your meter out-of-doors, there will be no danger of your not being able to remove it in time to meet the Government's re-sealing period. You will not be troubled by necessary return trips because the meter was not accessible. You will run no danger of legal troubles because the sealing date has expired. These new methods, particularly with the detachable meter, offer many possibilities for large economies in the future.

3. PROTECT YOUR REVENUE

Theft of current, politely called diversion of energy, has always been with us. In the past, however, with few exceptions the amount of theft had not been enough to worry the utilities. But during the last several years, undoubtedly because of the depression, theft of current has become very general and widespread. The loss from this source is estimated by different companies varying from as much as 25 per cent. down to a few per cent. Let us be conservative and assume that this amount is approximately 2½ per cent. The total revenue from the class of customers affected by this abuse for the year 1932 (in the United States) was one billion one hundred million dollars, and a loss of 2½ per cent. is, in round figures, 30 million dollars. This is a terrific sum of money. To get a better idea of how large it is, let us compare it with certain statistics covering crimes committed in the United States. For example, burglary of safes and vaults in that same year amounted to four and one-half million, jewelry theft two million, and

bank robbery one million eight hundred thousand. These are petty larceny compared to the thirty million due to theft of current.

I could give many cases where companies have kept a careful record of billings before means were taken to stop theft compared to readings after such protective methods were installed. I think, however, a couple will be sufficient to illustrate my point.

The report of the Meter Sub-committee, Mr. L. D. Snow, Chairman, given before the Northwest Electric Light and Power Association at Portland, Oregon, in May, 1934, gives the following tabulation:

| Group | Average Kw-hr. Before Installing Theft-Proof Meters | Average Kw-hr. After Installing Theft-Proof Meters | Increase |
|---|---|---|---|
| 1 | 380 | 1,107 | 190% |
| 2 | 1,483 | 2,481 | 67% |
| 3 | 962 | 2,663 | 177% |
| 4 | 1,027 | 1,578 | 53% |

Notice the great increase in registration when proper theft proofing methods were used.

Just one more case where a utility seemingly could not be persuaded to use theft-proof meters. In this case the salesman finally persuaded them to make a trial installation of 40 meters on the following basis:

If the 40 CS Universal Detachable Meters did *not* increase the registered kw-hr. at least 20 per cent. for the 40 installations, the customer need *not* pay for the meters.

The results given below so justified the foregoing proposition that this company is now an enthusiastic user of detachable metering.

| | Registration Kw-hr. |
|---|---|
| Before installing CS Detachable meters ............ | 1170 |
| After installing CS Detachable meters ............ | 3007 |
| The actual increase in registered kw-hrs. was ....... | 157 per cent. |

Again see the startling increase in revenue where theft-proof installations are made.

Now what is the remedy against this theft of current? First—have the meters out-of-doors wherever possible. Second—employ good theft-proofing methods of installation. By these means theft of current will be practically eliminated since by corrective methods you have made theft extremely difficult and you have placed the meter in public view where opportunities of tampering are decreased. There are many million meters in service. To police all these to eliminate theft is impractical. Place them out-of-doors, therefore, and let the public be your policeman.

Here again we see that to obtain these advantages we must use new and different methods.

So far I have dwelt principally on our present day needs, and only to a limited extent on the proper remedies How can we improve this situation? Probably I can best illustrate what I have in mind by describing the steps which have been taken in the United States, to solve this very important question of determining the proper type of metering installation in the years to come. In the early part of 1932, the Meter Committee of the Edison Electric Institute, and the Association of Edison Illuminating Companies, requested the meter manufacturers of the United States to get together and recommend a future standard. The requirements were:

1. The standard should be interchangeable with all manufacturers.

2. The standard could be relied upon to be unchanged for many years to come.

3. The standard should not restrict future meter developments as far as the measuring element was concerned. This part should be left free for any manufacturer to change as he pleased.

4. The terminal features, or junction features, should be standardized and unchangeable.

This task was not an easy one, and many meetings of the manufacturers were held before a report was made by them. This report was the basis of a standardization program adopted by the E.E.I. on May 2, 1934, and described in full in their Bulletin in May, 1934. Abstracts from this report give the basis of standardization as follows:

"The Meter Mounting and Energy Diversion Sub-Committees, at a joint meeting in Cincinnati on March 30, 1934, agreed upon a schedule of basic requirements applicable to single phase watthour meters and a common mounting device. The Committee on Metering and Service Methods of the Association of Edison Illuminating Companies was consulted and its support obtained.

"The manufacturers responded promptly, proposing a solution at a joint meeting held in New York City, on May 2, 1934. This proposal was received favourably by the Electric Light and Power group and the manufacturers were advised to proceed at once with its execution.

The Interchangeable Standardization Summarized

"This new interchangeable standardization briefly may be defined as follows:

(1) Henceforth all four manufacturers will offer two standard single phase meters:

*TYPE "A"

A bottom connected meter, similar to and interchangeable with the present type "A" line manufactured by the General Electric, Sangamo, and Duncan companies.

*TYPE "S"

A so-called socket or detachable meter, similar to and interchangeable with the present Westinghouse CS meter.

---

*Author's Note:—*

* The type "A" meter is the conventional type with terminal chamber located at the bottom.

* The type "S" is a socket type which plugs in like a radio tube.

* The type "B" is the type "A" meter with the ordinary terminal block replaced by one carrying testing links or similar features.

* The type "C" is the type "B" meter in a specially designed enclosing box.

(2) This standardization applies only in matters of meter housing and connection terminals. It does not in any way, concern the mechanisms and characteristics of the meter proper.

(3) The aim for the standard interchangeable meters, types "A" and "S", will be the maximum simplicity and economy consistent with effective and satisfactory operation.

(4) The present type *"B" and *"C" lines of equipment now manufactured by the General Electric, Sangamo, and Duncan Companies, will be continued.

Some question has been raised concerning the manufacturers offering two standards instead of one. It is generally felt, however, that this is desirable. Regardless of the type and design of a new meter mounting to meet the requirements as presented, there would undoubtedly continue an appreciable demand for an open terminal chamber, bottom connected meter interchangeable with and similar to those that have been used for several years. It will be a definite gain therefore, for this meter to be standardized among all of the manufacturers, in addition to the fully standardized new method of mounting which fits in well with the modern trend in meter installations and service wiring."

The committee had asked for one standard but manufacturers had suggested the two standards and this plan was adopted. You will notice, however, that while the so-called "A" meter was standardized, no enclosing feature or attachments were standardized. It is true the Committee recognized that the manufacturers would continue to offer the so-called "B" and "C" combinations, but they were not standardized. In short, all attachments or auxiliary features for the "A" meter were left to the judgment of each utility. On the other hand, however, the detachable form was standardized and you should note particularly the last part of the above report which reads:—

" . . . in addition to the fully standardized new method of mounting which fits in well with the modern trend in meter installations and service wiring."

I might add that since the above resolution was adopted, additional work has been done by the Committee to simplify the various type of sockets available and three standard sockets have been adopted as follows:

1. A socket with 2—1 in. diameter outlets which will meet the Underwriters' requirements.

2. A socket with 2—1 in. diameter outlets with back breakout.

This will take a slightly higher price with No. 1.

3. A special 3-way socket with back breakout.

This will be somewhat higher in price with No. 2.

Note No. 1:—1¼ in. diameter outlets will be supplied where desired, but these are to be at a slightly higher price than the 1 in. outlets.

Note No. 2:—Customers requiring smaller than 1 in. outlets will be asked to use 1 in. with reducing coupling.

Note No. 3:—It is agreed that the standard socket mentioned above should not include a by-pass. The latter is to be considered as special. The result of this standardization

work in the United States is that any company can now decide on which type of standard it desires, and can go ahead with a definite plan for revamping its meter system, with the confidence that whatever standard is adopted, will not be changed for many years to come. Such a change obviously cannot be made over night. It will be a question of adopting a plan and working consistently toward the objective over a period of years. To get the best results from such standardization work, some plan must be adopted.

But you may say that the outdoor plans would be rather easy to work out, but there will always be many meters used indoors such, for example—installations served from underground systems, also apartment houses and similar locations where many meters are grouped together. How, then, can our outdoor plans be harmonized with the necessary indoor meters?

Where one meter only is to be used indoors, I think it obvious that future tendencies will depart from the old conventional type of indoor installation with no protective features, and will tend exclusively toward a meter installation which is thoroughly theft-proof. Therefore, since the outdoor meter is always used with some theft-proof combination this outdoor practice can simply be transferred indoors whether it be the conventional or detachable type. Where one meter only is used indoors, therefore, there would seem to be no additional problem as compared to outdoor installations.

Where many meters are grouped together indoors, for the detachable type, the manufacturers have made available a so-called ring socket, which is adapted to be installed as the front part of a channel or trough. The method adopted by one company was described by Mr. A. J. Allen, in the *Electrical World* September 15, 1934. Brief abstracts from that paper illustrate this method:

"The new meter mounting which has been adopted by the New York Edison Company and United Electric Light and Power Company takes advantage of the standards now agreed upon. . . . The major feature of this development is a meter sub-base* which may be attached to a trough or an individual meter box. It incorporates many features which are for the prevention of energy diversion.

"Saving in cost of equipment and its installation for a group of twenty meters is approximately 30 per cent. of the cost where the conventional indoor meter equipment is used. Cost of installing the meters on the equipment is reduced approximately 25 per cent."

From the above it will be seen that the detachable meter, by means of sockets designed for a particular purpose, can be installed in any desired manner indoors or outdoors. The meter is the same in all cases.

The standardization program jointly worked out by the manufacturers and the users in the United States has been aimed toward reaching some final form, the mounting details of which will be interchangeable by all

* Arrangements are being made whereby any meter-cabinet manufacturers complying with working agreements can obtain the ring-mount sub-base from any of the meter manufacturers and supply with cabinets and accessories.

manufacturers. If this program can be carried out to the fullest extent, the advantages in the way of decreased expenses are obvious and much to be desired.

In deciding on the form to be taken by a possible future standard, it seems to me that the possibilities would group themselves under three classifications:

1. An enclosing box capable of taking any of the more popular meters in service and now being manufactured.

2. A terminal chamber meter of conventional form, but standardized as to the dimensions of the terminal chamber. This is similar to the "A" meter in the U.S.A.

3. A detachable form of meter which plugs in like a radio tube with socket and junction features interchangeable by all manufacturers. This is similar to the "S" meter of the U.S.A.

Let us analyze these three.

### 1. Enclosing Box

The use of such boxes is old, in fact they were in use before the standardization program was started by the Meter Committees in the U.S.A. in 1932. If an enclosing box had been the answer to this problem the Committees need not have asked the manufacturers to get together and offer a new standard. The fact that a new standard was called for by the Committees is proof that the enclosing box was not the answer. One objection seems to be that the original cost is high. In addition, it makes a double enclosure which is undersirable in many cases, owing to the dead air space around the meter and moreover, cases have been discovered where the outer box has been opened and resealed after cleverly concealed jumpers had been installed at the meter. These jumpers being concealed from the view of the meter reader or the ordinary inspector, may go for years without being discovered. I think, therefore, we can eliminate the enclosing box as the possible future standard.

This then leaves two methods to be compared and to assist you, I have listed in the columns below the various arguments as they appear to-day in our standardization program.

| Detachable Meter | Conventional Meter with Theft-Proofing Auxiliaries. |
|---|---|
| Meter terminals and socket details are both standardized. | Meter terminals only standardized. Attachments not standardized. |
| Socket interchangeability insured for future. | Attachment interchangeability not insured. |
| One enclosure, no auxiliaries. | Either double enclosure or meter with auxiliaries. |
| Adaptable to gang installation. | Not easily adaptable to gang installations. |
| No change in meter for different socket combinations either indoors or outdoors. | Meter terminal block must be changed for the "A", "B", or "C" combinations. |

| Detachable Meter | Conventional Meter with Theft-Proofing Auxiliaries. |
|---|---|
| Wiring permanently installed and need not be disturbed in testing and removing. | Wiring may have to be moved when testing and removing. |
| Old meters may be rebuilt to socket type at small expense. | Old meters not readily rebuilt for "A", "B", or "C" combinations. |
| Dead front. No live terminals handled in testing, removing or installing the meter. | Live terminals or links handled in testing. Live terminals or links handled when removing or installing. |
| Design is inherently theft-proof. | Added auxiliaries required to make meter theft-proof. |
| Decreased time required in installing or removing. | Time required for installing or removing not improved. |
| Facilitates disconnecting and reconnecting meters for Government reseal period. | No improvement for Government reseal period. |
| Low first cost. | Relatively higher cost. Particularly the box type. |
| In place testing time decreased. | In place testing time same as ordinary meters. |
| Lower costs in gang installations. | No savings in gang installations. |
| Future meter elements may be installed in same case. | May or may not be possible depending on design. |

The above detailed comparison, I hope, will assist you in analyzing your requirements, and help you determine the best form of meter for your future standard. I think a fair general statement would be that the conventional meter is simply the general type which has been in use for about 40 years, with the added feature that the terminal chamber portion is standardized as to its dimensions. There is nothing essentially new, therefore, in the so-called "A" meter. On the other hand, the detachable form is new, differing from past practice. You, therefore, must weigh the savings which are possible through the detachable form against the temporary inconveniences of changing from a form which has been in use for many years to a new form. I am not familiar enough with your individual systems to answer the question as to which form is the most desirable for your system. You naturally must answer that question for yourself.

The only information I can add which might be helpful to you in making a decision is to describe the tendencies in the United States. In an analysis undertaken by the Electrical World, and given in their February 16, 1935, issue, under the title "Meter Trends Forming," they draw the following conclusions:—

"The trend from indoor old-sequence to outdoor new-sequence in meter location is definitely established and growing rapidly."

The Electrical World goes on to

say that time has been too short to state whether the detachable form of metering is as yet tending to become the standard for the country. However, the same article does point out that many companies have adopted the detachable as standard, and the growth of this idea has been very rapid in its short life of only one year since standardization was effected.

The Electric Light and Power magazine made a survey to determine the meter trend and in an editorial in its issue of April, 1935, states:—

WHAT 49 METER SUPERINTENDENTS SAY

"Forty-nine meter superintendents tell us they are going to make more than half a million outdoor meter installations during the next five years. These figures all came from large companies and represent at least half the entire industry. The trend is quite definite and widespread. Only five companies report that they are not adopting outdoor meters. It will be remarkable if the number of installations during the next five years is not several times the million which this study would indicate.

"Of the forty-nine companies twenty-one state categorically that they are standardizing on the socket type of meter. This system of installation has gained a tremendous amount of ground recently.

"Most of the companies are putting meters outdoors because it reduces tampering. Practically everyone seems agreed on this point. Some companies also consider the greater ease of obtaining readings to be a big advantage. It is only in cities which have underground service, or where the customers live in apartments that outdoor metering is not being considered."

The progress made by the detachable meter is well illustrated by the fact that notwithstanding its short life, there are approximately 500,000 of these meters in service today. Every State in the U.S.A. has these meters installed in considerable quantity. In addition, the U.S.A. possessions listed below have taken a considerable quantity of these detachable meters.

Hawaii, Panama, Philippines and Porto Rico.

The detachable meter, as you know, has been used in Canada, the details of which are familiar to you. In addition we have shipped the detachable meter to other countries as follows:—

Brazil, Chile, China, Colombia, Costa Rica, Cuba, Ecuador, Egypt, Haiti, Italy, Japan, Mexico, Nicaragua, Norway and Sweden.

You will notice some of these countries have hot climates and some cold.

My personal feeling on this situation, which you may take for what you think it may be worth, is that the detachable form will eventually become the universal standard in the United States. This opinion is based on which I consider as the following facts:—

1. The opportunities for decreasing operating expenses are better with the detachable type of meter than with the conventional type.

2. The detachable is fundamentally the most economical form of supply-

ing a meter with thoroughly theft-proof features.

3. The separation of a meter from its junction features (the socket) insures flexibility of design which is not present in other types.

4. With the new sequence of meter ahead of the house fuses, safety to employees is very important. The detachable design is safe as it is the dead front type.

5. The same meter unchanged in any respect may be used outdoors in a standard socket, indoors in a standard socket, ganged together with other meters in a channel form of construction or installed in a socket form of meter box.

6. An analysis by the Electrical World and by the Electric Light and Power indicate a strong trend toward outdoor meters and toward the detachable form.

I have now laid down our needs and outlined possible future remedies, but what are you going to do about it? Will you try new methods in the hopes of finding different and better methods, or will you say it is impossible, the present methods are good enough? Will you say, the Canadian climate is very cold and severe, and we are afraid of having meters out-of-doors, or will you say, let us try it and see if the savings in maintenance expense are not possible? Will you say, there are too many different types of meters installed in Canada, and so standardization is practically impossible, or will you say, let us waive all our preconceived ideas and try to find a standard? In short, will you, as Edison advised, "Have the courage of your forefathers — GO FORWARD?"

## Human Moths

Light attracts not only bugs and insects but sales—as was proved by one Pittsburgh store, according to *Electric Topics*. In the ladies' ready-to-wear department they directed spotlights on three of the many revolving racks. Each day three different racks were selected and placed under the spotlights. They found that regardless of the type of dresses displayed the racks on which the floodlights were focused attracted the greatest number of customers. The sale of these dresses far outnumbered those on the other racks.

Another store learned the sales potency of light by a similar test. The illumination in a show case was increased from 12 to 20-foot candles, the percentage of people stopping was increased from 8 per cent. of the total aisle traffic to 11.8 per cent.—practically a 50 per cent. increase.

While on the subject we want to mention one more instance of the actual, tangible returns that follows the use of more light. A middle-west concern making radio coils and condensers, so reports *Your Plant*, replaced one indirect fixture in each bay by four 500-watt glass-still diffusers. The light was thereby increased from 8 to 50-foot candles. Output immediately increased 16 per cent., rejects set a new all-time low record, and worker's morale improved noticeably because of lessened eye strain.—*The Electric Journal*.

THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

# Method of Selling Lighting by Central Stations

**By J. E. North, President, Electric League, Cleveland, Ohio**

(*From a paper in three parts presented to Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, July 5, 1935.*)

## PART ONE

## SELLING BETTER SIGHT TO A MILLION PEOPLE

SIGHT SAVING COUNCIL ORGANIZED:

BELIEVING that eyesight conservation is of such major importance that it should rank with such activities as the long established movement to prevent and cure tuberculosis, a Sight Saving Council was organized at Cleveland on August 1st, 1934.

On that date, a number of civic leaders met to discuss the need for a local organization to disseminate information to the people of Cleveland on the many phases of eye care.

The first meeting was called at the suggestion of Miss Virginia Wing, Secretary of the Anti-Tuberculosis League, Secretary of the Health Education Committee, and an active member of numerous civic organizations.

At the organization meeting, Miss Wing stated, "For many years, humanitarian minded men and women of Cleveland have dreamed of an organization which would serve as a vehicle to carry to our public important knowledge that would help to conserve eyesight."

THE PURPOSE OF THE SIGHT SAVING COUNCIL:

After very brief discussion, it was unanimously agreed to organize the Sight Saving Council of Cleveland and it was declared that the object of the Council should be:

1. To endeavour to determine, through study and investigation, ways and means which will further the preservation of human eyesight.

## CONTENTS

Vol. XXII No. 8
AUGUST, 1935



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

2. To disseminate knowledge concerning all matters pertaining to the preservation of human eyesight.

The civic leaders present at the organization meeting selected as Chairman of the Council, Henry B. Dates, Professor of Electrical Engineering, Case School of Applied Science. Miss Virginia Wing was selected to serve as Executive Secretary.

It was decided that a hundred or more prominent citizens should be asked to serve as members of the Council and to function as a General Committee. One hundred and seventy people were informed concerning the plans of the Council and accepted an invitation to serve as members of the General Committ e

EXECUTIVE COMMITTEE:

It was deemed necessary to have a small committee to plan and direct the activities of the Council, consequently an Executive Committee was created. Civic leaders in attendance at the organization meeting served as a nucleus for this committee, and additions were made to the membership of the Executive Committee. Finally it included:

President, Cleveland Council, Parent-Teacher Associations;

President, Federation of Women's Clubs;

President, Cleveland Safety Council;

Secretary, Catholic Charities Corporation;

President, Academy of Medicine;

Secretary, Cleveland Society for the Blind;

President, Electrical League of Cleveland.

Publicity Chairman, Cleveland Community Fund;

President, Advertising Club;

Members of the Ophthalmological Club;

and other professional and business men and women known to have an unselfish motive in promoting the objects of the Council.

ACTIVITIES:

It was decided that the activities of the Council should include:

1. Furnishing trained speakers to give chart talks at meetings of Parent-Teacher Associations, women's clubs, fraternal, business and social organizations.

2. To endeavour to obtain publicity through newspapers and local magazines.

3. To conduct exhibits and demonstrations to illustrate and explain the facts about the alarmingly high number of children, college students and

adults that have defective vision, why the number is increasing, and what should be done to decrease eyestrain, eye defects, and generally improve seeing conditions for the people of the community.

4. Publication and distribution of printed material which would aid in the conservation of eyesight.

COMMITTEES:

At the beginning the Executive Committee of the Council decided that the following Annual Committees should be appointed:

1. Program Committee
2. Speakers' Committee
3. Publicity Committee

Special committees to look after the details of Sight Saving Day and other activities which do not continue throughout the year are appointed as occasion demands.

FINANCING ACTIVITIES OF THE COUNCIL:

It is through the efforts of the Executive Committee of the Council that voluntary subscriptions have been secured. Contributions have been made by members of the Executive and General Committees and others, much in the same way that contributions are made to other non-commercial philanthropic organizations.

THE ELECTRICAL INDUSTRY'S PART:

The Electrical League of Cleveland, representing the Electrical Industry, has one membership in the Council, and while the Industry stands to benefit commercially, it has from the beginning divorced its commercial operations entirely from the Council, doing its part in the Sight Saving movement as an interested local factor, but leaving the guidance and activities to the Council itself.

The Council always has found the League ready and willing to help to carry on the original purposes of the Council.

COMMERCIAL VS. PHILANTHROPIC INTERESTS:

It has been said that there might be considerable criticism if sight saving should be promoted by professional men who sell optical goods or services and others who sell lighting equipment. This depends entirely on how the original plan is presented. Obviously, most movements which deal with the health of the individual, or prolonging of life will commercially benefit someone. The whole subject of dental hygiene is recognized as an important factor in health and must benefit the dentists and makers of tooth brushes and tooth paste. Driving out typhoid, for example, benefits commercially the medical profession as well as pharmaceutical producers and dealers.

It all depends on how vital and worth-while the movement is. Certainly the subject of eyesight is so broad and so vital to human welfare that a great deal should be done about it irrespective of who benefits commercially and this attitude is always obtained when once all the local people understand the aim of the movement.

If the subject of seeing is presented merely as a means of interesting people in more light, it is fundamentally unsound and doomed to failure. Better light is one of the means, and a major one, of protecting eyesight, but eye examinations and care of the eyes are extremely important.

### NOT A CAMPAIGN:

In the words of Dr. William Evans Bruner, a member of the Executive Committee, "The Sight Saving Council must of necessity be permanent in character. To attempt to carry out the broad aims of the Council in a few short weeks, or even months, would only serve to defeat its purpose.

"Because of the very nature of the subject of eyesight conservation, it must be a program of long-time education, in order that its full significance and importance may be impressed upon the minds of the whole citizenry.

"And, because there are so many phases of the subject to be taken up, to attempt to carry them on simultaneously would do nothing more than confuse the public, make them lose sight of the important fundamental purpose behind the movement, which in turn would serve to make them lose interest and confidence in the work.

"Therefore, I say that ours is not a one-year plan, nor even a five-year plan. I say that we must embark on a ten-year plan at least, in order that the full aims and purposes of the Sight Saving Council may be realized."

### HAS THE SIGHT SAVING COUNCIL OF CLEVELAND BEEN SUCCESSFUL IN ITS EFFORTS?

Before reporting accomplishments by the Council, one point should be made clear and that is that its program has been aimed at prevention and does not include any attempt to prescribe or cure eye defects.

This point is made as a suggestion to avoid confusion in the minds of people who contemplate the organizing of a Sight Saving Council.

Briefly, the results accomplished by the Council during the past year have been as follows:

1. *The Speakers' Committee* have made chart talks to 139,498 people. This figure does not include the people reached through 13 radio broadcasts which were conducted by the Chairman of the Speakers' Committee.

Remember that the Sight Saving talks are divided into three parts:

1st, Facts about eye failures.

2nd, Why there is an increasing number of people with defective vision.

3rd, Recommendations on how to reduce eye-strain and improve vision.

2. *The Publicity Committee* is credited with the preparation and distribution of 257,283 Sight Saving booklets. This number does not include the distribution in Cleveland of thousands of booklets and leaflets produced by the Better Vision Society, the Society for the Prevention of Blindness, and other organizations.

The editors of a total of 56 daily and weekly newspapers and of class publications co-operated to the extent of printing 6,245 column inches of Sight Saving copy in their news columns.

Up to the date of this report, June 27th, there have appeared in 36 English and 20 Foreign Language newspapers, a total of 689 articles including 326 photographs.

It is interesting to note that on the basis of 180 column inches per newspaper page, the editorial copy which has appeared in Cleveland papers during eleven months, if assembled in one newspaper, would be equivalent

to nearly 35 full pages devoted entirely to the subject of Sight Saving.

Sight Saving Day:

Friday, May 3rd, was selected as Sight Saving Day. Most of the arrangements and preparations for this activity were handled by one of the most prominent oculists.

Through the co-operation of seven Cleveland hospitals, and with the aid of approximately 30 members of the Ophthalmological Club, 1,972 eyes were examined.

This free service was aimed at people who could not afford to pay for eye examinations.

The advance announcement stated that this service would be available only to adults and children under school age. This decision was made in view of the fact that provisions are made in the schools for free eye examinations.

The Accomplishments of the Sight Saving Council may be summed up as follows:

First, 170 of the most representative citizens of the community have taken an active part in the program to attempt to make Cleveland *the best seeing city* in the country.

Second, the importance of eye care has been brought to the attention of more than a million people in Cleveland's three hundred thousand homes, and it is known that a reasonable percentage of the people have taken steps to reduce eyestrain and improve or avoid conditions which tend to promote defective vision.

Recommendations:

In view of these facts, recommendations are made that right now is the time to create a non-commercial organization in every community to carry on a Sight Saving program.

* * * *

## PART TWO

## SELLING BETTER LIGHT TO A MILLION PEOPLE

LET us take a page out of a good book,—a good book on the subject of "Selling". It reads:

"Don't sell things, sell ideas, feelings, self respect, home life, health and happiness.

"Don't sell merely for the sake of selfish gains, but be of real service to your fellow man and the community in which you live."

There's good salesmanship in a nut shell.

It is just human nature to want things that contribute to health, happiness, comfort, enjoyment and pleasure.

When any human emotion or desire is sufficiently aroused, the sale is as good as closed.

The good book goes on to say:

"Sell personal appearance and attractiveness, to sell clothes.

"Sell the joys and profits of knowledge, to sell books."

Is this not sound advice for the people who wish to sell current-consuming devices and kilowatt hours?

Then it follows that we should sell

the benefits of better light. Sell elimination of eye strain, sell health and social advantages. Sell accuracy, speed of vision, and pleasant surroundings. Sell protection of the most precious human possession.

Orders for more and better lighting equipment are sure to follow.

If we sell the need for better lighting equipment in homes, we sell the need for better lighting in stores, offices, and factories.

When the suggestion was made at the Edison Electric Institute meeting at Atlantic City in June, 1934, that local Better Light—Better Sight bureaus be created and that the membership be composed of people interested in selling optical goods and services, paint and lighting equipment, it occurred to me that in such a committee selfish interests might result in confusion and that the real purpose would not be accomplished.

It was decided that a better plan would be to have a Better Sight activity to be followed by a Better Light activity.

Consequently, following the usual procedure of advertising and selling, first consideration was given to the educational or Better Sight program which has previously been explained.

Separate committees were formed, the first to deal with eyesight conservation and the importance of light in conserving eyesight. The second committee was composed entirely of the men who are primarily interested in the sale of brass, glass, kilowatt-hours and the things that had to do with selling merchandise and electricity.

We then set out to use the tools which had been rather recently provided:

1. The Sight Meter
2. The information on the Science of Seeing
3. Sight Saving Lamps

As you will recall, about a year ago many manufacturers were not enthused about, consequently not optimistic about the demand which might be created for study lamps, and the samples which had been submitted to portable lamp buyers had been condemned.

In many cases portable lamp dealers were very definitely of the opinion that nothing beyond artistic appearance of portable lamps counted with the prospective purchaser, and consequently they decided that strange appearing portable lamps, designed more for their light giving qualities than artistic appearance could not be sold.

Fortunately, a few people had very definitely decided that right, or rather light in this case, would prevail, consequently determined that two kinds of portable lamps should be recommended to the public—the old models of portable lamps for their ornamental beauty, and the new study lamps for their sight saving qualities.

As stated, few manufacturers were enthused in the early stages about the possibilities of selling many study lamps, consequently it became necessary to "pep up" a local manufacturer.

Fortunately our optimism resulted in the designing and producing of six new study and sight saving lamps.

It was necessary to call on all of the department stores, furniture stores, and other lamp dealers, (nearly a hundred in all) and explain in detail the merits of the new study lamp.

In advance of these calls on dealers

a local manufacturer had been influenced to produce an ample stock to sample these dealers.

A merchandise promotion man from the Utility called on the dealer, displayed a sample of the new study lamp, explained its merits, and endeavoured to persuade the dealer to engage in the sale of this new portable lamp.

After a few calls on dealers it was decided that we not only should sell the merits of the new lamp but make each dealer a present of the first lamp and a window card explaining its merits.

However, in this particular case we found that the manufacturer did not have an ample selling force to follow up the prospects for study lamps, and we decided that in order to avoid any lost motion we should employ a man to represent the manufacturer to follow the sales promotion man and secure orders for a sufficient quantity to meet the anticipated demand.

Consequently it was decided that the merchandise promotion man would call one day and explain the merits of the new study lamp to the dealer, and if he expressed interest, present him with a sample lamp to put in his window with a suitable window display card, and then arrange with our representative who was loaned to the manufacturer, to follow the next day and secure the order for a stock of lamps.

May I explain that this procedure was necessary in view of the fact that the Central Station Company in Cleveland does not sell, and has not sold, merchandise of any kind for more than 25 years.

To assist dealers in selling study lamps, it was decided that one of the best methods of popularizing this new product would be to permit a number of representative people in the community to enjoy the benefits of study lamps. Seeing is believing.

No opportunities were lost to present, with the compliments of the League, study lamps to Presidents of Parent-Teacher Associations, and others, including oculists, optometrists, editors and writers, (a total of approximately 350) who would appreciate and recommend study lamps.

Of all the promotional expenditures made, this unquestionably was one of the most productive.

Our next step to sell better light was to employ and train, as recommended by the bulb manufacturers, five women to experiment with the advantages to come from making home lighting surveys and recommendations.

It is suffice to say at this point that this experiment proved that higher wattage bulbs, sight saving portable lamps, and consequently better light could be sold to the advantage of manufacturers of lighting equipment and the Central Station.

To announce, introduce and publicize the new Sight Saving lamps, a Science of Seeing Show was arranged by the Electrical League and announced to the public.

In an orderly procedure the visitors to the show were reminded of the increasing number of eye failures, why eyes are failing, and how lighting changes could be made to improve seeing conditions.

Demonstrations were made, intensity demonstrators were used to indicate the amount of light required for

accurate and speedy vision, and equipment was used to show the amount of light indicated by the sight meter which might be obtained from old style lamps, low wattage bulbs and improper shades in comparison with increased wattage and modern light giving lamps and lamp shades.

This show and the demonstrating equipment aided greatly in convincing not only the public but buyers of portable lamps that the time had arrived when consideration should be given to portable lamps for their light giving qualities as well as their ornamental beauty.

To further promote the sale of study and sight saving lamps, it was decided to offer to the department stores a co-operative plan which included advertising, the demonstration and sale of study lamps and three-light (100-200-300 watt) sight saving lamps.

This included first, the hiring and giving two weeks training to sales demonstrators, second, the production and furnishing gratis of sight saving demonstrating equipment which included:

1. A cut-away display of the sight saving lamp.

2. An intensity demonstrator to prove the need for higher intensities for reading and sewing.

3. Because of the high ceilings in retail stores, a platform with a ceiling height which might be found in the average home, was furnished to demonstrate the advantages of indirect lighting.

4. The co-operative proposal also provided that the Central Station ugh the League would pay 50 per cent. of the display advertising space devoted to sight saving lamps.

This service was furnished to department stores about the middle of October and continued until December 25th.

The results are extremely interesting:

First, while study lamps and three-light lamps were only introduced about September 1st, several stores reported that two-thirds of the portable lamps sold during the month of December were of the study and three-light types.

Second, it is most gratifying to state that approximately 30,000 study and sight saving lamps have been sold in Cleveland since September 1st, 1934.

It was not expected that study lamps equipped with 100 watt bulbs would greatly increase the Central Station revenue, but as I have stated, the study lamp is one of the tools to acquaint the people in homes with the advantages of better light and how it tends to eliminate eye strain and improve vision.

And, may I call your attention to the fact that the two separate programs, the first to sell Better Sight and the second to sell Better Light in homes, have resulted in impressing the people who work in offices and in factories with the need for better lighting conditions.

As a result of the experiment of putting five home lighting consultants in the field, additional women were employed to do this work and it is the plan to employ and train 50 women to start on September 15th, 1935, to make home lighting surveys, lighting recommendations, and replace bulbs in the homes of people

who can be sold on the idea of improving their lighting conditions to conserve the eye-sight of the members of the family.

The subject of this paper is "Selling Better Light to a Million People". Granted, a very ambitious goal, but certainly in all merchandising programs we should aim high.

We admit that while our plans were well organized, they were not perfect.

While we believe that a reasonably high percentage of our people have been impressed with the importance of eye-sight conservation and the importance of better light, we cannot claim credit for having sold better light to a million people.

We must be content to know that the importance of better sight has been brought to the attention of a high percentage of a million people, a reasonable number have decided to improve lighting conditions, and lighting conditions have been improved in 10 per cent. of the homes.

Certainly with a continuation of the educational activities through the Sight Saving Council, and a continuation of the efforts of the commercial group to sell better light, much is to be accomplished in the conservation of eye-sight and the sale of lighting equipment and kilowatt-hours during the coming years.

* * * *

## PART THREE

## A ONE MAN SELLING JOB

A Suggested Plan to Centralize Responsibility, Eliminate Duplication of Effort, and Have One Man in Each Contractor's Organization Interest the Prospect, Do the Engineering, Consumate the Sale and Sufervise the Installation.

IT is needless to dwell long on the good old days when electric lighting was just coming into its own. There was a time when all of us were busy filling the orders of stores and factories who wanted electric light and didn't care much about the details of that light just as long as it was electric. But all of you will recognize that the cream of that type of business has been skimmed off and it has become evident that the industry must, to a large degree, look to a modernizing of existing installations for further expansion of business. Of course, we know that a vast majority of stores and factories are under-lighted, but these factories and stores either do not know it, or are not much concerned about the fact. At any rate, they have stopped coming to us and saying, "I want electric light", and it is clearly up to us to go to them and sell the benefits of more and better light. Quite apparently this calls for selling rather than order-taking, and the question, "Who will do the selling job?"

It is evident that the contractor, the wholesaler, the manufacturer and the public utility will all benefit from the sale of higher standards of lighting. But because the benefits are spread over so many sources, and because the sale of lighting requires a high type of trained salesmanship, it

looks as though no one is doing an adequate and complete selling job.

It is an old story that there would be big money for all branches of the industry if modern standards of lighting were sold to all the stores and factories. This has been pointed out many times with many figures, and I know that you and I have attended many meetings where it was agreed that because of the nature of lighting it must be sold co-operatively. Oftentimes elaborate plans for co-operation have been unfolded and enthusiastically received, and oftentimes the participants have been disappointed in the results.

Many times we have seen co-operative advertising campaigns prepared for promoting the sale of industrial and commercial lighting but when it comes down to the very necessary co-operation selling of this lighting it has not been done. This is not difficult to understand in the face of the figures on the following chart.

WHEN THE CUSTOMER BUYS $100.00 OF ADDITIONAL LIGHTING EQUIPMENT

$100.00—Is Received by Contractor.
(50% Labour—50% Materials)
$30.00—Is Received by Jobber.
$24.00—Is Received by Manufacturers.
$40.00—Annual Revenue is Created for the Central Station.

Note:—Amounts Approximately Correct.

### Amount of Money Received by Jobber, Contractor, Manufacturer and Central Station from a $100.00 Installation:

When the customer pays the contractor $100.00 for an industrial or commercial lighting installation, let us assume that $50.00 is for labour and $50.00 for material.

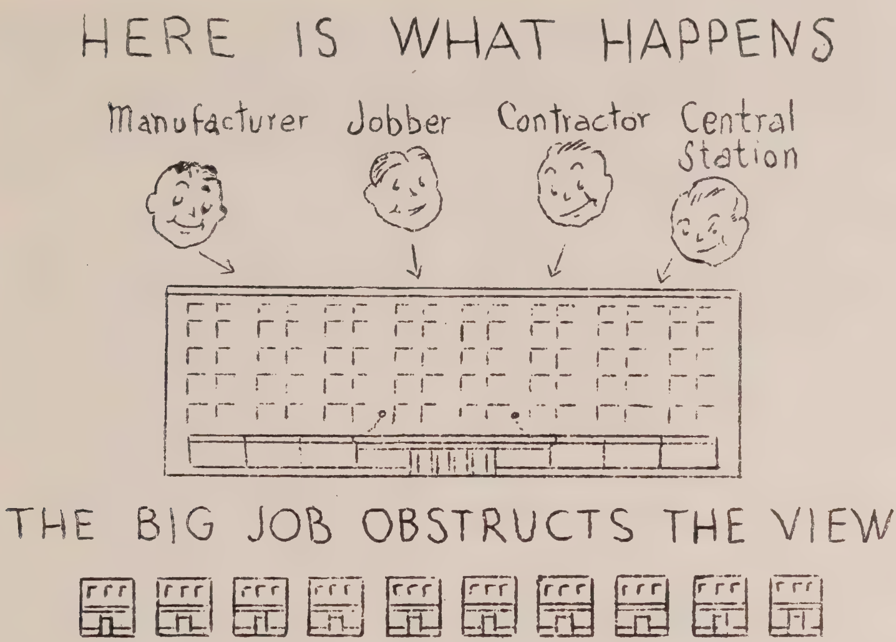
The jobber receives approximately $30.00 from the contractor or 60 per cent. of what the contractor collects for materials, the manufacturer receives $24.00 from the jobber, and the Central Station receives approximately $40.00 revenue the first year.

With the money split up that way, no one factor can afford much selling expense.

### Everybody Concentrating on Large Prospect:

The net result is that the greater part, or practically all the selling effort is put on the large prospects. The Central Station is very likely to have several well trained men doing this kind of selling, but there are only a few of them and they cannot begin to cover the territory. The lamp manufacturer is adding his selling effort, but he, too, lacks the man power and the profit possibilities to do an extensive job. The jobber finds it difficult from his percentage of the business to pay the expenses of a lighting specialist and the contractor who is by necessity mechanically minded is not set up to do the intensive and extensive selling job required.

The result is that only approximately 6 per cent. of the industrial floor space, and about 4 per cent. of the commercial area has been sold




good lighting, which leaves a tremendous market receptive to the selling program if such a program can be set up in a way that the entire market can be really covered with profit to all and excessive expense to none.

Out of the $100.00 collected by the contractor, he can very justifiably spend 10 per cent. or $10.00. The jobber can spend 5 per cent. of his $30.00 or $1.50. The manufacturer can spend 5 per cent. of his $24.00 or $1.20, and a considerable number of

WHAT MAY BE JUSTIFIABLY SPENT IN SELLING A $100.00 INSTALLATION

| | | | |
|---|---|---|---|
| Contractor | 10% of | $100.00 | $10.00 |
| Jobber | 5% of | 30.00 | 1.50 |
| Manufacturer | 5% of | 24.00 | 1.20 |
| Central Station | 25% of | 40.00 | 10.00 |
| Total | | $194.00 | $22.70 |

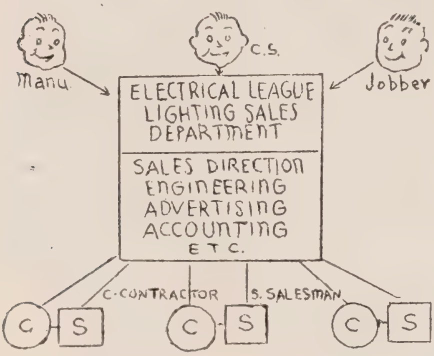
JUSTIFIABLE OVER-ALL SELLING EXPENSE PER $100.00 SALE:

Let us look again at the money received from the sale of a $100.00 installation, and note what amount each of those who benefit from the sale might feel was justifiable.

public utilities interviewed on the subject have indicated that they would be willing to spend all the way from 20 to 38 per cent. of the revenue for the first year. Twenty-five per cent. of $40.00 seems like a fair average or $10.00. This gives us a

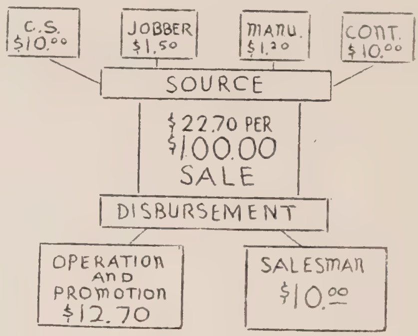
total of $22.70 which may very reasonably be spent to produce the $100.00 sale without working a hardship on anyone.

Now, does it seem logical that if instead of the contractor calling on a customer, and the jobber calling on the same customer, and the Central Station and the manufacturer calling on him, each with a part of a lighting story, that a better job could be done by one salesman, highly trained, a specialist on the subject, and representing them all. This is true, if the $22.70 was lumped and he was paid from that, he could be much better paid than if his salary had to come from any one of the interested parties.




Organization Built Around Electrical League Lighting Sales Bureau:

Suppose then that through the Electrical League, or the utility where there is no League operation, we set up in the community, a Lighting Sales Bureau. Let this bureau furnish a high type of sales direction, provide an engineering service, an advertising and promotional campaign and the essential accounting and clerical facilities. Then, let the department hire and train salesmen of the high type and intelligence required to sell lighting. Employ enough of these salesmen to secure accurate coverage and definitely assign each salesman to a specific contractor.




Source and Disbursement of Income:

Figures on the foregoing chart are of course but tentative and put down merely to convey the idea.

In general let us say that for each $100.00 installation sold, 10 per cent. is to be collected from the contractor, 5 per cent. each from the jobber and manufacturers, and 25 per cent. of the revenue for the first year from the Central Station. Of this total which amounts to $22.70, let us say that approximately $10.00 would go to the salesman and the balance for the overhead and operation of the Lighting Sales Bureau.

It would only be necessary to set up an initial operating fund to get this department going, and thereafter the operation would be self-sustaining. All parties supporting this set-up would only be required to contribute a portion of their sales receipts which would be derived directly from the activity.

The compensation of salesmen is, of course, a very important factor in such a program where it is necessary that the compensation be liberal to attract the calibre of man required to do the job.

Salesman's Compensation:

It is recommended that the commission be high on the smaller jobs because there are a great number of these which the aggregate would give a fine volume but which would not attract the salesman unless the commission were worth while.

A sliding scale will encourage the salesman to concentrate on the smaller jobs which need the most attention and also enables the contractor to better meet competition on the larger jobs where close figuring is necessary. The commission on sales would be paid by the contractor into the common fund and our experience in selling lighting indicates that the average percentage paid by the contractor would be 10 per cent.

the salesman would collect $2,000 for such an installation, which in addition to being a handicap to the contractor, experience has shown would spoil the salesman ever after for going after the small and necessary installations.

With this plan and the salesman making a report of sales to the department, the salesman would naturally report all sales in full in order to secure his maximum commission, but would be prevented from over-reporting due to the fact that the contractor has to pay these commissions into the fund.

At the time the salesman reports to his headquarters, copies of his report would be sent to the wholesaler and to the manufacturer supplying equipment used in the installation. It would permit the manufacturer and wholesaler to check on their sales and confirm or protest the report. Inspection of installations would be made by the department headquarters for approval of the salesman's report.

RESULTS FROM THE SALE OF 1,000 KW OF NEW LIGHTING BUSINESS

| | Receipts | Cost of Operation |
|---|---|---|
| Contractors | $75,000.00 | $7,500.00 |
| Jobbers | 22,500.00 | 1,125.00 |
| Manufacturers | 18,000.00 | 900.00 |
| Central Station | 30,000.00 | 7,500.00 |
| Totals | $145,500.00 | $17,025.00 |

Twenty thousand dollar jobs do not grow on bushes, but on this sliding scale basis, a salesman would be well compensated for securing it. On the other hand, if the commission was paid on a straight 10 per cent. basis,

Estimated Receipts and Cost of Operation for 1,000 Kw. New Business:

Naturally before a plan of this kind is put into effect in any city, consideration would be given to the

number of industrial and commercial meters, and based upon the possibilities of the market a quota would be established.

Depending upon the size of the city, the quota may be five or ten times as great as the figures used in the above example.

It is interesting to note that if we add to the contractor's sale the amount to be received by the jobber, the manufacturer, and the Central Station, then the total amount of the sales is $145,500.00.

In all the previous calculations the maximum justifiable selling expense has been applied.

This has been done because it is not the intention that commissions should be paid to salesmen or any of the promotional expense should be applied to the business which comes in over the counter, through the contractor and/or the utility.

It is probable that the cost of operation would be less than the amount shown above.

It is to be remembered that while the total cost amounts to $17,025.00, this amount will not have to be raised in advance, but will be largely produced during the period of operation of the plan through sales that have actually been made.

With this amount of money a real selling job can be done,—a job which will be more effective than has ever been possible in the past.

Finally, it would seem that this plan means for centralization of responsibility. It should tend to reduce confusion in the minds of prospects which come from several prescriptions by too many people who in many cases are not prepared to make engineering recommendations, consumate the sale, supervise the installation, which after all should be handled by one man delegated and authorized to represent the several branches of the industry.

# Report of Load Building Committee

AT the January Convention a request was received by the Executive of the Association from the H.E.P.C. that a committee be formed of members of the executive committee, to work with a committee of Hydro engineers to develop plans for load building whereby all types of load in Hydro municipalities might be increased.

As a result of this request a committee composed of the President, Vice-President, past President and the Directors from the membership at large, was formed, and to the membership of this committee were added representatives from Toronto, Hamilton, Sarnia and Chatham, and this committee, along with Messrs. R. T. Jeffery, J. J. Jeffery, G. F. Drewry, J. N. Wilson, H. D. Rothwell, T. C. James, J. H. Caster, M. M. Inglis, and G. J. Mickler, as representatives of the H.E.P.C., formed a main load building committee.

This main committee met shortly after the Convention and formed a number of sub-committees to study various branches of load building and methods of promoting load building activities in Hydro municipalities.

The following sub-committees were formed:—

Committee No. 1—Budget and Finance Committee.

Committee No. 2—Sales and Advertising Committee.

Committee No. 3—Loads Committee.

Committee No. 4—Lighting Committee.

Committee No. 5—Range and Water Heater Committee.

Committee No. 6—Adequate Wiring Committee.

Committee No. 7—Industrial and Commercial Applications Committee.

Committee No. 8—Service and Maintenance Committee.

Committee No. 9—Data and Surveys Committee.

Committee No. 10—Rural Committee.

The chairman of each of these sub-committees was a member of the main committee and to each committee were appointed representatives of Hydro municipalities and the H.E.P.C. Municipal Department.

The functions of each of the sub-committees were clearly defined and the members of the sub-committees were informed of their appointments and apprised of the field to be covered by their respective sub-committees.

Meetings of the various sub-committees were held and reports submitted to the main committee on February 20th, 1935.

Summary of these reports is as follows:—

### Sub-Committee No. 1—Budget and Finance Committee

After reviewing the recommendations of the other committees involving the expenditure of monies the Budget and Finance Committee recommended that:—

(1) An appropriation be set aside by the H.E.P.C. to provide general and promotional advertising.

(2) An appropriation be set aside by the H.E.P.C. to carry on a provincial lighting campaign.

(3) An appropriation be set aside to conduct a provincial range campaign.

(4) Appropriation for the range campaign be a general charge to be paid for by all municipalities in the Province as part of the cost of power.

The appropriations asked for by the Budget Committee were provided by the H.E.P.C. on March 8th, 1935.

SUB-COMMITTEE NO. 2—SALES AND ADVERTISING COMMITTEE

Recommended that:—

(1) An appropriation be set aside per annum for campaign and publicity purposes.

(2) Each Hydro municipality engage as survey men, individuals properly trained to explain Hydro service to consumers and try to build up a feeling of confidence and better service to Hydro users.

(3) Welfare organizations should be educated into the value of quelling discontent among this class.

(4) A talking picture be prepared to tell the Hydro story, illustrate the various undertakings under Hydro control, promote electric cooking, lighting and other uses, and couple with this a dramatization of the use of important equipment, and with the aid of a newsreel provide means for educating and entertaining Hydro consumers.

(5) Vocational and High School students should be contacted to acquaint them as well as the teachers of these institutions with Hydro.

(6) Electrical industry should be mobilized to take hold of a Load Building Program. (The formation of a manufacturers' Committee is under way.)

(7) Hydro Superintendents must be stirred up to the importance of a load building effort.

Simultaneously with the appearance of local range advertising the Commission authorized a series of five institutional advertisements which have appeared in the principal daily and weekly newspapers of the Province during the past two months.

Subsequent to the submission of their report the Sales and Advertising Committee approved of plans for conducting a Provincial range campaign and some features of a lighting campaign.

SUB-COMMITTEE NO. 3—LOADS COMMITTEE

Recommended that:—

(1) The rate form for Commercial Lighting consumers should be revised to invite more load. Referred back to committee for recommendations.

(2) Lower Water Heater Rates were recommended for smaller municipalities based on the cost of additional power, not on the average cost as at present. Referred back to committee for recommendations.

(3) Estimates be prepared to show effect of load increase to municipalities on the cost of power for 1935-36, based upon increases of 5, 10 and 15 per cent. per annum.

SUB-COMMITTEE NO. 4—LIGHTING COMMITTEE

Recommended that:—

(1) The H.E.P.C. should inaugurate a Lighting Campaign as soon as possible, covering all phases—Domestic, Commercial, Industrial and Highway Lighting.

(2) The H.E.P.C. appoint a lighting director and staff to direct lighting activities of the Commission and assist municipalities to conduct local campaigns.

(3) The H.E.P.C. sponsor a School of Lighting Instruction to be held in Toronto the week of March 12th.

(4) All Municipal Engineers attend the School to equip them to sell the lighting idea to Hydro municipalities, and stimulate interest in their respective districts.

(5) An invitation be sent to all Hydro municipalities to send one or more students to attend this School at the expense of the municipality.

(6) Following this School, the H.E.P.C. provide facilities to continue a course of instruction in proper lighting.

(7) As a nucleus to such facilities, the Solex Company has indicated a willingness to donate the services of their Lighting Expert, Miss Eleanor Potts, for the use of Hydro municipalities in promoting better lighting.

During the week of March 12th a lighting school was held in Toronto, a report of which appeared in the Hydro Bulletin of April, 1935, and it will be found on studying this report that some of the recommendations of the Lighting Committee were fulfilled.

Plans are under way now to follow up the results of the lighting school with a lighting campaign, and it is hoped that by October the plans will be matured.

### Sub-Committee No. 5—Range and Water Heater Committee

Recommended that:—

(1) With some modifications, a Range Campaign as proposed last year should be launched as soon as possible.

(2) The bonus originally proposed to be donated by the H.E.P.C. be given to municipalities to apply as they saw fit subject to general approval of the H.E.P.C.

(3) Instead of a general advertising program, involving expenditures by the H.E.P.C. for general advertising, it was proposed that Range advertising be confined to local advertising, prepared by a competent advertising agent and that each municipality receive compensation to defray part of such local advertising, based upon actual range sales.

(4) Leader ranges of high quality should be a feature of any range campaign.

(5) Five year terms on financing range sales favoured to meet gas competition.

Based upon the recommendations of the Range and Water Heater Committee a Range Campaign Manual was prepared to enable Hydro municipalities to organize local range campaigns to show various branches of the industry how they should co-operate to put a range campaign over, also Instructions to Range Salesmen, and How to Sell Electric Cooking, as well as provide a complete advertising campaign for local advertising purposes.

Based upon this manual a provincial range Campaign was launched on April 15th, and the results of the campaign thus far have been reported from time to time in the bulletin, the *Hydro Ranger*, published for the purpose. Copies of this bulletin are

circulated among all Hydro municipalities, municipal engineers and the manufacturers.

Up to date over 100 Hydro municipalities have agreed to co-operate in this campaign and this involves close to 400,000 Hydro consumers. The scope of the campaign includes Hydro rural customers, urban and suburban, as well as those under municipal jurisdiction.

*Re: Water Heaters*

(1) Booster water heaters should be supplied free as Flat Rate heaters now are, and rentals removed.

(2) Flat Rates for heaters should be lowered, especially where gas competition prevails.

Shortly after the recommendations of the Range and Water Heater Committee were made known approval was granted by the Commission to remove the rental charge for booster water heaters, and there has been a marked increase in the number of booster water heaters installed since that date.

At the opening of the Range Campaign, water heater advertising was supplied by the Commission to Hydro municipalities to further the sale of flat rate and booster water heaters and the installation of this equipment has taken on a decided impetus during the last two months.

### Sub-Committee No. 6—Adequate Wiring

Recommended that:—

(1) The standards of wiring covering residential, commercial and industrial wiring, set up by the Electric Service League of Toronto, be adopted as standards to be recommended to all Hydro municipalities.

(2) The Committee is to co-operate with the Electric Service League in the preparation of a booklet—"Electric Wiring of a Modern House", now being revised, to distribute among Hydro officials, contractor-dealers and wiremen in Hydro municipalities.

The booklet mentioned herein has not yet been completed so it is not yet ready for distribution.

### Sub-Committee No. 7—Commercial and Industrial Applications

(1) Recommendations made that every industry in Ontario be surveyed with a view of obtaining information on the present use being made of Hydro power and possible uses to which power may be applied. To facilitate in this work a uniform survey form is submitted for approval.

(2) Information on power applications to various industries is available in the form of a pamphlet issued by one of the manufacturers of power equipment. It was recommended that such a pamphlet be adapted to the use of Hydro municipalities to enable local managers to study power requirements of their customers. Referred to Committee to secure pamphlet.

### Sub-Committee No. 8—Maintenance Committee

It was recommended that:—

(1) A regular inspection of consumers' equipment in all municipalities be made by them for the purpose of insuring that range elements, switches, as well as other electrical appliances, are kept in proper repair. Referred back to Committee for plan based on plans in use in Windsor, Walkerville, London, Galt and Hamilton.

(2) The H.E.P.C. prepare specifications for replacement range elements, in which the size and quality of wire which goes into the manufacture of such elements be specified.

(3) Contact be made with manufacturers of range switches to standardize on switches—and facilitate repairing and replacing of defective equipment. Referred back to Committee for action.

(4) The matter of installing terminal connection for electric ranges be considered to facilitate the installing of ranges. Referred to Adequate Wiring Committee.

### Sub-Committee No. 9—Data and Surveys Committee

(1) Recommended that a survey be made of every employee of the H.E.P.C., Hydro municipal staffs, and every electrical manufacturer of importance to determine what use is being made of electrical appliances by those on whom we must depend to boost electric service.

To facilitate this work, a form was drawn up to be distributed to all branches of the industry for the necessary information.

### Sub-Committee No. 10—Rural Committee

(1) A Committee was appointed to study the problem of educating rural consumers through the medium of special pamphlets to be distributed periodically to each rural consumer.

(2) A Committee is also studying suggested methods of merchandising electrical equipment in rural districts.

Preparatory to rural merchandising activities a survey has been made of customers in rural power districts to ascertain what electrical equipment they are now using and what immediate propsects there are for more equipment. A canvass has also been made of the non-users of electricity in each rural power district to determine what prospects there are for new contracts for service.

Plans are being laid for the keeping of continuous records in connection with the use of Hydro by rural customers and of prospects which develop from time to time as canvassing is done.

### General

Meetings of all of these sub-committees will be held from time to time to perfect plans for continuous load building effort.

### Summary of Accomplishments

1. Secured funds for advertising program and institutional advertising has already commenced.

2. Secured funds to promote Lighting Campaign—plans are being developed to carry on in the fall. The Lighting School was held in Toronto during March, 1935.

3. Secured funds to promote a Range Campaign. Campaign is under way involving over 75 per cent. of the domestic consumers of the Province.

4. Plans under way to survey every industry in the Province with a view to ascertaining where and how more power can be used.

5. A complete survey has been made of all Hydro rural customers to determine what electrical appliances and equipment are in use and what prospects there may be to increase their use.

6. A study being made of the best methods of promoting the use of

Hydro to rural customers and how best to merchandise electrical equipment.

7. The H.E.P.C. has taken space in the Canadian National Exhibition.

8. We have a panel of Committees at work and available at any time to consider special load building problems and develop plans for campaigns.

9. Plans are being developed for a strenuous campaign to keep electrical appliances in service in all municipalities.

10. Plans are also under way to promote adequate and a higher standard of house wiring in Ontario to permit the use of more electrical appliances.

# Resuscitation

**By Wills Maclachlan, Electrical Employers Association**

(*From an address and demonstration to the Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, July 5, 1935.*)

AS you have seen by the press there was broadcast to the papers in Canada a new method of artificial respiration, so-called, the Danish method. This came out in ordinary boiler plate to all the press of Canada. It has appeared in the Maritimes and I know it has appeared as far west as Calgary.

When it came to the Toronto papers they put it up to Dr. Crawford, the Provincial Coroner, and he asked me to go and work it out with some of the life savers, and about two or three weeks ago we tried the method out. I tried it out on five men; the last was the Superintendent of the life saving station, Hilliard Lang. They all felt that the Schafer or Prone Pressure Method was superior to the so-called Danish Method which had received so much publicity.

To make the thing doubly certain, we tested the method a week ago last Monday at the Toronto General Hospital. I tried it out on one of my assistants, using a spyrometer or gasometer that would measure the amount of air he breathed out and breathed in.

We operated over a period of five minutes to work out any irregularity. The Danish Method had an exchange of tidal air slightly less than normal breathing and the Schafer or Prone Pressure Method, as we carried it out, was sixty per cent. more efficient than the Danish Method.

I wished to have this opportunity of making this statement because of the way the Toronto papers reported the tests we made at the life saving station. They gave the impression that I, for one, was recommending the Danish Method or that we, after the test, found it was better. The reverse is absolutely true. We were all sold on the method we were teaching and thought it was very much superior to the Danish Method.

With your permission and if some one is available, I will show the two methods.

(A demonstration of the two

methods of resuscitation was given by Mr. Maclachlan).

In electric shock cases we have to move the man lying down. We can't carry stretchers on line waggons. We can carry blankets. After you resuscitate the man—you have had a blanket under him to keep the heat in his body—take six or eight men; kneel down and start rolling the blanket in tight, pulling away from the man all the time. This stretcher was shown by one of the doctors of the Red Cross some years ago and I think all line gangs in Ontario use it now.

Now, if I could emphasize again for you the points in resuscitation from electric shock: The first is to get the man clear of the current as quickly as you can. You will usually find him thrown clear.

The next point is to start resuscitation with as little delay as possible. I want to absolutely emphasize that. Our results with the quick commencement of artificial resuscitation are excellent; with the delay, they are not so good. You have got to get started with as little delay as possible. That means that every man in your gang must be trained.

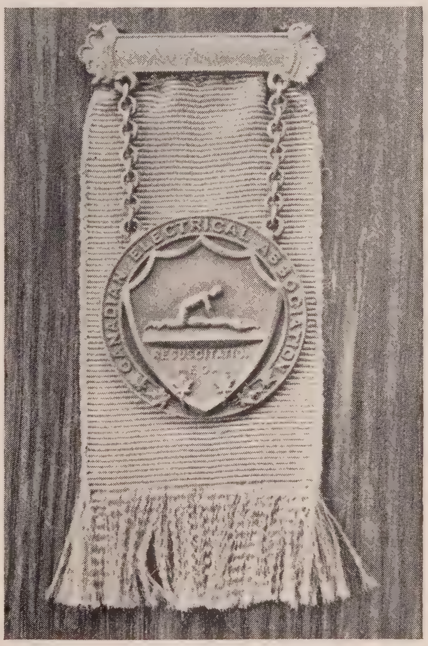
The next point is use warmth. That has not been emphasized enough in the past.

The next is, carry out the artificial respiration until the man breathes or definite signs of rigor mortis are evident. We have carried on for eight hours and brought the man to. Don't take any man's word that the case is hopeless until there are definite signs of the stiffening of the body. All the doctors in this Province have been so advised by the Ontario Medical Association and the students are being so trained in the medical schools to-day.

After you have brought the man to, do not allow him to sit up or stand or you may lose your man.

## Resuscitation Medal Presented

On February 16, 1935, J. A. Kuhn, on the station maintenance staff of the Operating Department, received an electrical shock in Kitchener high-tension sub-station. Fellow employees in the sub-station at the time, by prompt action and the application of the Prone Pressure Method of artificial respiration, were responsible for resuscitating him and thereby saving a life.




*Canadian Electrical Association Resuscitation Medal.*

*J. A. Kuhn and the men who successfully resuscitated him. From left to right they are: Geo. Boucher, C. L. Boucher, A. H. Hannon, J. R. Nelligan, G. S. Webb, and J. A. Kuhn. J. T. Paton was absent on vacation.*

On Tuesday, July 30, 1935, on the lawn of the Preston sub-station, the Canadian Electrical Association Resuscitation Medal was presented by Wills Maclachlan acting for the President of the Canadian Electrical Association, to George Boucher, C. L. Boucher, A. H. Hannon, J. R. Nelligan, J. T. Paton, and G. S. Webb. A letter from T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario, congratulating the men, was also read and presented to each man. After the immediate presentation, a number of those present spoke in high terms of the excellent work that had been carried out by these men. One of the most interested participants in the presentation was Mr. Kuhn.

There were present from the Hydro-Electric Power Commission, H. C. DonCarlos, H. J. Muehleman, A. W. Manby, G. T. Brown, Jas. H. Rogers, J. S. Martin and C. D. MacDonald. From the Kitchener Public Utilities Commission there were present Karl Krantz, Commissioner, and V. S. McIntyre, Manager; and from the Preston Public Utilities O. J. Little, Chairman, Jas. Leslie, Commissioner. Reeve E. L. Mosack and Alderman W. J. Pelz of Preston were present also. Hespeler Public Utilities was represented by V. F. Hunt, Superintendent and other officials. Many others of the staff of the Hydro-Electric Power Commission and interested municipalities took part in the proceedings.

# Air Conditioning
## Its Present and Future Economic Possibilities

**By E. C. Williams, Manager, Air Conditioning Sales, Canadian General Electric Co., Limited.**

*(Presented to Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, July 4, 1935.)*

IN considering the present and future economic possibilities of air conditioning, it seems desirable to first define what is meant by the term "Air Conditioning". In the present state of the art, Air Conditioning may be defined as the simultaneous control of temperature, humidity, air movement and purity to produce the optimum of conditions for physical comfort and health.

Conditioning air for comfort and health is both an old and a new art; old, because its beginning dates back to days when slaves fanned their masters with palm leaves and new, because it is only within very recent years that advances in engineering knowledge have made it possible to bring air conditioning within the financial reach of anyone but an eastern potentate.

It is the intent of this paper to show that air conditioning is no longer the perquisite only of those rich enough to own human slaves, and that the benefits to health and comfort which air conditioning brings with it are now within the reach of those of average financial resources. As a basis for discussion, it is proposed to give a brief description of a line of typical equipment, showing where it can be applied, with approximate figures as to the installed cost of each component of the line and an estimate of its seasonal power consumption and operating cost. It must be appreciated, however, that the figures given are approximate only, as while the same model of air conditioner may be used in a number of similar applications, the installed cost will vary for each one owing to the different types of building construction encountered, and the difference in location of the units with respect to power and water supply mains, etc. Power consumption and annual operating cost will also be found to vary within quite wide limits for similar applications due to differences in building construction, exposure, the number and habits of the occupants, etc.

For convenience, the units to be described will be grouped into three classes according to their most common application. It will be understood that the units listed in any one class may be, and not infrequently are, used on applications that fall in either of the other two classes.

For the sake of simplicity, only 60 cycle equipment will be considered. However, 25 cycle equipment is available and the corresponding figures for it will not vary to any great degree from the 60 cycle data given.

### Domestic Units

For a better understanding of the equipment that may be classified under this heading, it seems desirable to

consider first the conditions the equipment is required to correct.

Extensive investigations by a number of independent authorities of the condition of the air in the average Canadian home during the winter months has established three important facts:—

1. That the relative humidity of the air may, during severe weather, be as low as 10 per cent., and that relative humidities of 20 per cent. or less are very common under normal winter conditions

2. That the dust content of the air is considerably higher than normal.

3. That the temperature distribution throughout individual rooms is generally poor and that differentials of 10 deg. fahr. or more between ceiling and floor air are more often the rule than the exception.

It has also been amply demonstrated that if an improvement is brought about in one or more of the above conditions, the health and comfort of the occupants will be materially improved.

Obviously then, if a winter air conditioner is to correct the three conditions mentioned, it must be equipped with a humidifying device of sufficient capacity to hold the air in the home at the proper relative humidity; include a fan of the proper size to create a gentle circulation of air, thereby preventing it from stratifying into layers at different temperatures; and must also include a means for adequately filtering the air that it circulates in order to remove the entrained dust particles, thus improving the purity of the air breathed by the occupants. Finally such an air conditioner must be available at a price that will bring it within the buying range of the average small home owner, which means that the price must be comparable to that of a good radio or refrigerator.

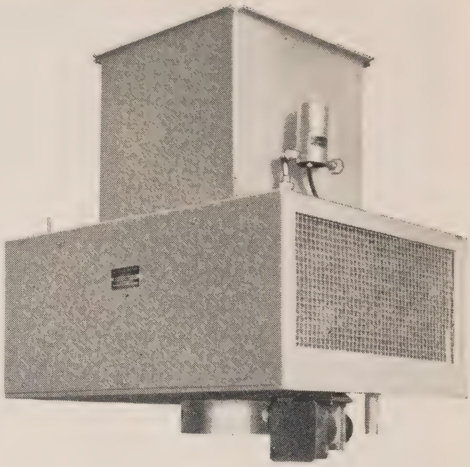


*Fig. 1—Exterior view of G. E. Type AC-1 Air Conditioner.*

Unfortunately, it is not yet possible to furnish in this price bracket a unit of sufficient capacity to condition the air of a complete home. However, units are available in this price range with sufficient capacity to provide winter air conditioning for the downstairs living quarters and with sufficient humidifying capacity to maintain the relative humidity at the proper value throughout the entire house.

One unit that meets these specifications in the line under consideration is shown in Fig. 1.

This unit, designated as type AC-1, is designed to provide air circulation, filtering and humidifying in homes already equipped with steam or hot water radiators. It may also be used in conjunction with hot air heating systems, where a suitable supply of

hot water for its operation can be obtained economically.

The unit consists of filters, humidifying units, flexibly mounted motor and a directly connected propeller fan, assembled in a sturdy cabinet and provided with an outlet for under-floor mounting. An external heater is provided for heating the water used for humidification. The fan is operated continuously under manual control and the humidifier is controlled automatically by a humidistat located in the living quarters.

*Performance Characteristics.*

(a) Air Circulation—Free delivery—400 c.f.m.

(b) Humidification—1.2 gallons per hour with 180 deg. fahr. humidifying water and 70 deg. fahr., 30 per cent. relative humidity entering air.

(c) Water Consumption—8 to 10 gallons per hour while humidifying.

(d) Power Consumption for 5,000 hour heating season—210 kw-hr.

(e) Operating Cost for 5,000 hour heating season based on power at 1c. per kw-hr., coal at $14.00 per ton. Metered water at 13c. per 1,000 gallons.

| | |
|---|---|
| Power | $2.10 |
| Coal | 10.00 |
| Water | 1.30 |
| Total | $13.40 |

Note:—It may be argued quite logically that this fuel cost is not chargeable to the humidifier since if this heat is not put into the house by humidifying water, it would of necessity have to be put into the house direct by the heating system in order to maintain the house temperature.

*Approximate Installed Cost.*

$275.00

Note:—This unit may be installed without ducts dependent upon whether or not the basement air is fit for circulation through the house. In many cases this ideal condition is not found, consequently a small amount has been included in the installed cost for simple duct work.

The next system to be considered for the home is one of the central plant type that is capable of delivering properly conditioned air to every room in the house by means of suitable ducts. Such a system may be obtained to furnish winter, summer, or year round air conditioning as desired. The most common type of system in Canada at the present time is one for winter air conditioning and this can readily be converted into a year round system by the installation of additional equipment. A description of it will be given together with a description of the additional equipment required for summertime operation.

As a system of this type is designed for use in place of the conventional domestic heating plant and as the part of the system that furnishes the necessary heat is closely tied in with it, it seems in order to give a brief description of it, even although oil furnaces as such do not come within the scope of this paper.

This furnace incorporates in one co-ordinated unit a welded steel boiler, an oil burner mechanism and completely automatic control. The whole equipment is insulated to prevent heat wastage or the transmission of noise and is completely enclosed in

*Fig. 2—GE type LA-4 Oil Furnace.*

a steel jacket finished in two-tone grey.

The combination of fine atomization of the oil fuel in a new type, low pressure jet, proper distribution of primary and secondary air and a boiler specifically designed for oil burning, provides heat at high efficiency and low cost. An interesting all-year round feature of the furnace is the automatic provision of domestic hot water by a heating coil located in the boiler.

The furnace is available in two sizes with a maximum heat output of 133,000 and 275,000 B.t.u. per hour respectively. It is suitable for use with:

1. Steam Heating Systems.
2. Vapour Heating Systems.
3. Hot Water Heating Systems.
4. Indirected Heating with Air Conditioners.

A view of the 133,000 B.t.u. furnace is shown in Fig. 2.

In the line under consideration the units, required to provide a complete system for winter air conditioning, will consist of an oil furnace as the source of heat and an air conditioner known as the type AA-3 (or AA-4 according to capacity) in which the air is filtered, heated and humidified and then delivered to the duct system under pressure for distribution throughout the house. A cut-away view of a typical system is shown in Fig. 3.

The type AA-3 Air Conditioner consists essentially of two sections, the upper one containing the heating coils, humidifier and the manifolds to which the supply ducts are connected and the lower section containing the blower, blower motor, belt drive, dust filters and a Sonic filter for noise reduction. The frame holding the filters is equipped with a flange for the return duct connection. The filters can be readily withdrawn for cleaning through openings covered with removable doors at the end of the filter frame. Fig. 4 shows a view of the unit with covers removed.

*Performance Characteristics*

(a) Air Circulation—1200 to 1600 c.f.m. at 70 deg. fahr. (dependent on pulley size).

(b) Humidification—1.25 gallons per hour when operating continuously.

(c) Water Consumption—14 gallons per hour while humidifying.


*Fig. 3—A Cut-away View of a Typical System. A—G. E. Oil Furnace. B—G. E. Air Conditioner. C—Domestic Hot Water Tank. D—Oil Storage Tank. E—G. E. Thermal Control. F—Humidistat. G—Supply Ducts. H—Return Ducts. I—Steam Radiators.*

*Operating Cost.*

The figures given are for a winter air conditioning system consisting of one 133,000 B.t.u. oil furnace and one type AA-3 winter air conditioner. Such a system would furnish heated, humidified and purified air to every room in the house except kitchen, bathroom and laundry; these may be heated with steam radiation. It would also furnish domestic hot water the year round. Space will not permit the detailing of all conditions necessary to establish a definite load thus permitting close estimates of operating costs, however, some figures can be given that will be typical for eight-roomed houses of average size and construction.

Costs are based on power at 1c. per kw-hr. and metered water at 13c. per 1,000 gallons and are computed for a 5,000 hour heating season.

| | |
|---|---|
| Power Cost—750 kw-hr. at 1c. per kw-hr. . . . . . . . . . . . . . | $7.50 |
| Water Cost—14,000 gallons at 13c. per 1,000 gallons . . . . | 1.82 |
| | $9.32 |

The total cost for fuel oil to furnish all the heat required in the house for the 5,000 hour heating season will be approximately the same as if the

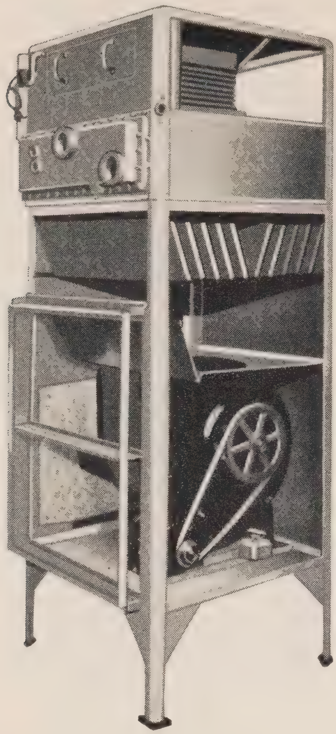


*Fig. 4—View of G. E. Type AA-3 Air Conditioner with covers removed to show construction details.*

house was heated with a conventional furnace burning coal at $9.50 per ton.

The total cost of running the oil furnace during the summer months to furnish domestic hot water only is equivalent to using power for the same purpose at 1/3c. per kilowatt-hour.

NOTE—The above two statements are based on a fuel oil cost of 10c. per Imperial gallon.

*Approximate Installed Cost.*

The installed cost of a 60-cycle winter air conditioner with oil furnace, oil tanks, domestic hot water tank, all ducts, piping and radiation to make a complete heating and winter air conditioning system for an average eight-roomed house, based on present day prices, will be approximately $2,500.

From the foregoing description of the winter air conditioning system, it is readily apparent that all that is required in the way of additional equipment in order to provide air conditioning for summer, as well as winter, is the addition of cooling coils and a refrigerating unit. Such equipment can be readily added to this system, either at the time it is originally installed, or at a later date, since the refrigerating unit is mounted separately, and relatively simple changes are required in the return air duct connections to the AA-3 unit in order to accommodate the cooling coils, otherwise the same ducts may be used.

The addition of the cooling coils provides the means for dehumidification of the air during the summer months, without additional equipment, as the introduction of the cold coil surfaces into the air stream causes a certain percentage of the moisture in the air to condense out, the amount being dependent upon the difference in temperature between the coil surface and the wet and dry bulb temperatures of the air. A schematic cross section of such an air conditioning system, arranged for year round service is shown in Fig. 5.

## PUBLIC ACCEPTANCE OF DOMESTIC AIR CONDITIONING

In the domestic field, manufacturers of air conditioning equipment look for a rapidly increasing acceptance of this new aid to comfort. It is generally conceded that the

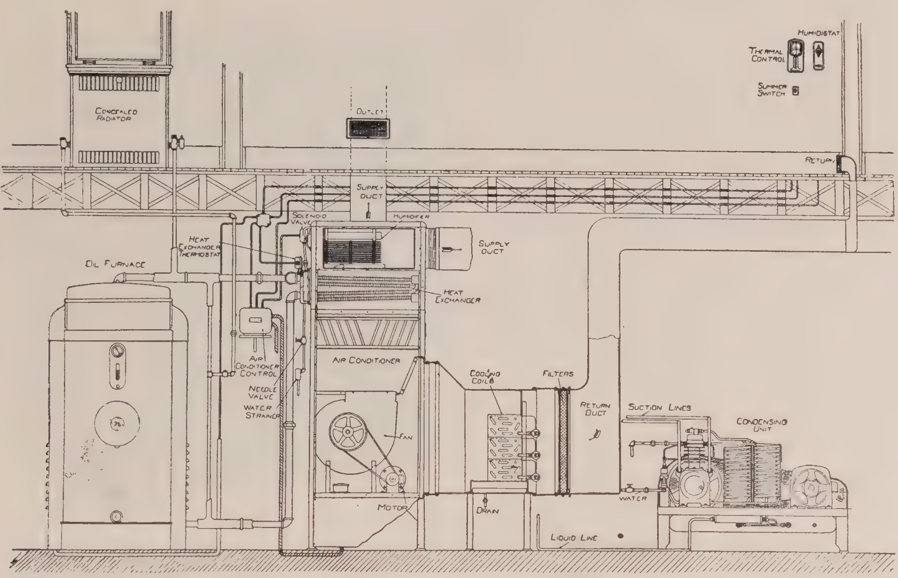



*Fig. 5—Schematic cross section of G. E. Air Conditioning system arranged for year round service. (For winter service only, the condensing unit and cooling coils in return duct would not be employed).*

trend of this acceptance will be first towards the installation of low cost winter air conditioners of the type shown in Fig. 1. This will be followed by a much wider acceptance of the complete type of system as shown in Fig. 5, particularly in the better types of houses.

How long it will be before the general public demands air conditioning as a necessity for the home, it is not safe to predict. In the United States, business leaders are predicting that within the next five years air conditioners will be almost as common as radios. Certainly, the Canadian public is displaying considerable interest in this new engineering accomplishment as is clearly indicated by the numerous articles on the subject that are constantly appearing in trade papers and the popular press.

Already two independent groups of business men are developing plans to build a considerable number of modern, low-priced houses which will include air conditioning as one of their main features.

Within recent weeks, Guidazio and Company, a firm of builders in Montreal, started construction of two seven-roomed houses, each to include complete year round air conditioning. It is interesting to note that the connected load for each one of these houses for air conditioning purposes only will be approximately 3.5 kilowatts.

Summing up this division of the paper from the Electric Utility's point of view, it can be predicted with reasonable assurance that within the next few years a considerable volume of load will be added to their resi-

dential lines. There is a definite need for air conditioning in Canadian homes. The public is interested in it, and air conditioners are rapidly being brought within its buying range.

### Individual Room Units

Units that may be classified under this heading are those that are designed primarily to provide economical air conditioning in spaces to which it is impossible or impractical to run ducts from a central plant. These units in the main find their field of application in places where it is desired to condition the air of only a few individual offices, hotel rooms, restaurants, or maybe a small store, etc.

In the line under construction, the units can be divided into four types.

1. Room coolers for floor or wall mounting.
2. Store coolers for ceiling mounting.
3. Portable room coolers with integral condensing units.
4. Year round air conditioners with either integral or remote refrigerating units.

Room coolers, in general, are designed primarily for comfort cooling applications where the following air conditioning functions are required.

1. Cooling.
2. Dehumidifying.
3. Circulating.

*Room Coolers for Floor Mounting.*

This cooler is available in several capacities, a typical one being designated Model AG-1. This consists essentially of a steel framework upon which is mounted the cooling coils, the fan and motor assembly, heat interchanger, drain pan, expansion valve, switch, etc.

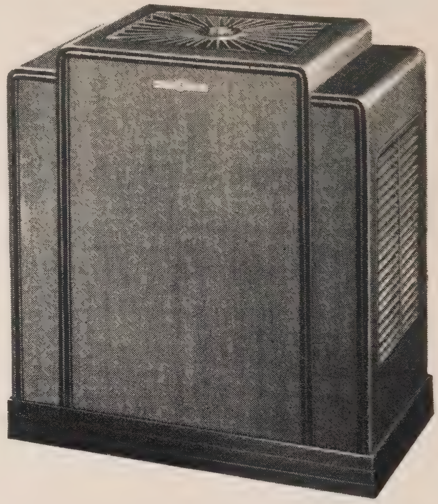


*Fig. 6—Exterior view of GE type AG-1 Floor Mounted Room Cooler.*

The action of the aphonic fan draws air through louvres in the side of the cabinet over the cooling coils where it is cooled and de-humidified and then discharges it through a grille in the top of the cabinet. The condensate, which drips from the cooling coils, is collected in a drain pan that is connected to the sewer. This unit is shown in Fig. 6.

*Performance Characteristics.*

(a) Air Circulation—Free delivery 475 c.f.m.

(b) Cooling Rate—7,400 B.t.u. per hour when entering air temperature is 80 deg. fahr. and relative humidity is 50 per cent.

(c) Seasonal Power Consumption based on 400 hours cooling spread over three months—400 kw-hr.

(d) Seasonal operating cost based on 400 hours cooling spread over three months. Power at 1c. per

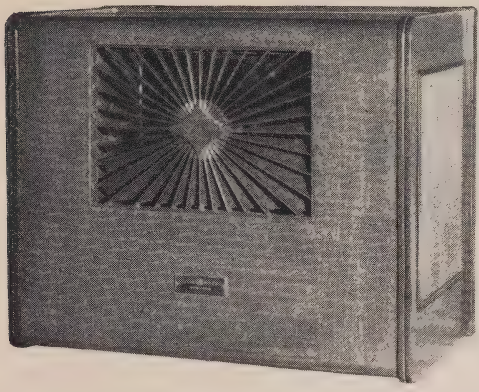


*Fig. 7—G. E. type AG-4 Wall Mounted Cooler.*

kw-hr. Metered water at 13c. per 1,000 gallons (includes cost of operating refrigerating unit).

| | |
|---|---|
| Power .......... | $4.00 |
| Water .......... | 3.12 |
| TOTAL ....... | $7.12 |

*Approximate Installed Cost.*
$750.00.

NOTE:—Approximate installed cost includes refrigerating unit. It has been assumed that a suitable drain connection is available at the cooler site, and that refrigerating unit is mounted within 20 ft. of the cooler, and that a power supply is available at the refrigerating unit site.

*Room Coolers for Wall Mounting.*

This cooler is available in several capacities and it is, in general, very similar in construction to the floor mounted cooler except that it is arranged for wall or ceiling mounting. It employs the same fan, motor, heat interchanger and cooling coils as the previous unit, and is designed for installation in places where floor space is not available. This unit is shown in Fig. 7.

*Store Coolers.*

This cooler, known as the type AG-14, is available in several capacities and the description of a typical size is as follows:—

It consists of an outer steel shell, finished in grey, containing finned tube cooling coils, thermostatic expansion valve (Freon models only), motor driven fan and condensate drip pan. It is arranged for ceiling mounting by means of straps or angle iron. It may be directly connected to a suitable refrigerating unit or may be run in multiple with other store or room coolers or air conditioners. It may also be used with circulating cold water as the cooling medium. Control may be either manual or thermostatic and moisture removed from the air is carried away through a drain.

The outer steel case is not removable but has removable panels. The right end panel, when removed, permits ready access to the unit for making all electrical and refrigerant connections. Two designs of fans and fan motors are provided to permit duct or ductless distribution of air. This unit is shown in Fig. 8.

*Performance Characteristics.*

(a) Air Circulation—Free delivery, 1200 c.f.m. Duct delivery against .06 in. static pressure, 1210 c.f.m.

(b) Cooling Rate—37,500 B.t.u. per hour when entering air temperature is 80 deg. fahr. and the relative humidity is 50 per cent.

(c) Seasonal power consumption based on 400 hours cooling spread over three months—1200 kw-hr.

(d) Seasonal operating cost based on 400 hours cooling spread over

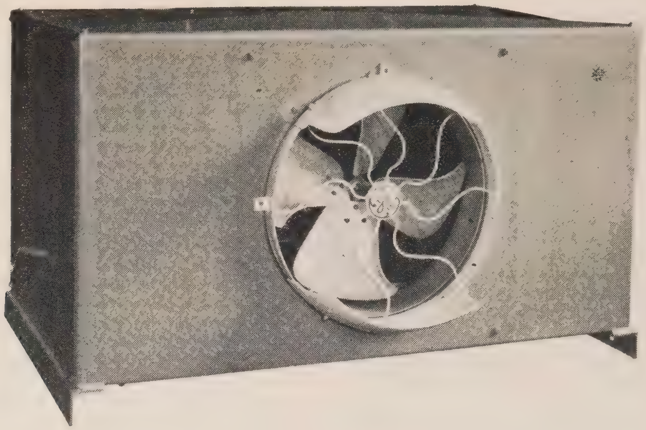


*Fig. 8—Exterior view of G. E. type AG-14 Store Cooler for Ceiling Mounting.*

three months. Power at 1c. per kw-hr. Metered water at 13c. per 1,000 gallons (includes cost of operating condensing unit).

| | |
|---|---|
| Power | $12.00 |
| Water | 8.32 |
| TOTAL | $20.32 |

*Approximate Installed Cost.*

$1,575.00.

NOTE:—Approximate installed cost includes refrigerating unit. It has been assumed that a suitable drain connection is avilable at the cooler site and that the refrigerating unit is mounted within 20 ft. of the cooler and that a power supply is available at the refrigerating unit site.

*Portable Room Cooler.*

The portable room cooler, known as type FC-1, consists of a water-cooled refrigerating unit enclosed in a galvanized steel, sound absorbing case, and a cooling unit using an aphonic pressure type fan, all mounted on a common base, having rubber-tired wheels and enclosed in a satin walnut finished steel cabinet. The unit is provided with cord and plug for connecting to a baseboard receptacle. Flexible hose is used for connecting it to the cooling water supply and drain. The moisture condensed on the cooling surface is

*Fig. 9—G. E. type FC-1 Portable Room Cooler.*

collected in a container accessible through a door at the end of the unit. The container may be emptied periodically or connected to a gravity drain through a flexible hose. An exterior view of this unit is shown in Fig. 9.

*Performance Characteristics.*

(a) Air Circulation—Free delivery, 200 c.f.m.

(b) Cooling Rate—4,800 B.t.u. per hour when entering water temperature is 60 deg. fahr., entering air temperature 80 deg. fahr., and the relative humidity is 50 per cent.

(c) Water consumption—30 gallons per hour when operating at maximum capacity.

(d) Seasonal power consumption based on 400 hours cooling spread over three months—220 kw-hr.

(e) Seasonal operating cost based on 400 hours cooling spread over three months. Power at 1c. per kw-hr. Metered water at 13c. per 1,000 gallons. (Includes cost of operating condensing unit).

| | |
|---|---|
| Power . . . . . . . . . | $2.20 |
| Water . . . . . . . . . | 1.56 |
| Total . . . . . . . | $3.76 |

*Approximate Installed Cost.*

$595.00.

Note:—It is assumed that suitable connections for power, water supply and return are available at the location of the unit.

*Year Round Air Conditioner (Self-Contained Type).*

The unit air conditioner known as type FR-1 is completely self-contained and it is designed to provide all the functions of year around air conditioning as follows:—

Summer—Cooling and de-humidifying.

Winter—Heating and humidifying.

Year round—Ventilating, circulating and filtering.

The unit consists of a satin walnut finished steel cabinet, enclosing a water-cooled refrigerating unit encased in a galvanized steel, soundproof cabinet; a cooling coil with expansion valve; a heating coil with a motorized valve; a humidifying unit with solenoid valve; a plenum chamber with two speed dual blowers, as well as filters, drain pan, fresh air duct and sufficient connections to make the unit completely self-contained.

A control panel is mounted on the front of the unit to permit manual selection of the air conditioning functions desired, and it is interlocked to prevent selection of incorrect combinations. The humidifying, heating or cooling operations are automatically contolled by means of a room humidistat and thermostat respectively.

To improve temperature distribution and prevent air stratification, manually adjustable louvres are provided in the front of the unit so that the air, when heated, may be deflected towards the floor and, when cooled, deflected towards the ceiling. This unit is shown in Fig. 10.

*Performance Characteristics.*

(a) Air Circulation—200 c.f.m.

(b) Humidification — 0.18 gallons per hour when operating continuously.

(c) Water Consumption — When

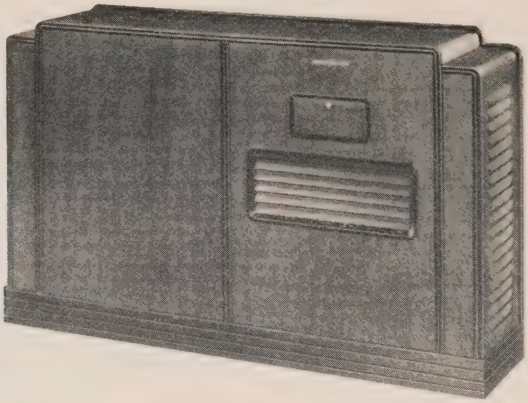


*Fig. 10—G. E. type FR-1 Self-contained Unit Room Air Conditioner for year round service.*

heating, 2 gallons per hour. When cooling, 90 gallons per hour.

(d) Maximum heat output when supplied with steam at 2 lb. per sq. in. gauge—11,500 B.t.u. per hour.

(e) Maximum Cooling Rate—8,600 B.t.u. per hour when entering air temperature is 80 deg. fahr. and the relative humidity is 50 per cent.

(f) Seasonal power consumption based on 400 hours cooling spread over three months—440 kw-hr.

(g) Seasonal power consumption based on 5,000 hours heating season—260 kw-hr.

(h) Seasonal operating cost based on 400 hours cooling spread over three months. Power at 1c. per kw-hr. Metered water at 13c. per 1,000 gallons. (Includes cost of operating condensing unit).

| | |
|---|---|
| Power | $4.40 |
| Water | 4.68 |
| TOTAL | $9.08 |

(i) Seasonal operating cost based on 5,000 hours heating season.

| | |
|---|---|
| Power | $2.60 |
| Water | .26 |
| TOTAL | $2.86 |

NOTE:—Re (i) To obtain the complete heating cost, the cost of the steam required must be added to these figures. This cost will be approximately the same as if the same space was heated by conventional radiators.

*Approximate Installed Cost.*
$1,000.00.

NOTE:—This cost is based on the assumption that suitable connections for power, steam, water supply and return, and gravity drain are available at the unit site.

*Year Round Air Conditioners with Remote Refrigerating Unit.*

The chief difference between this unit and the self-contained year round air conditioner, previously described, is that the refrigerating unit is not mounted within the same cabinet as the air conditioner, but is arranged for separate mounting. Otherwise, these two units are practically iden-

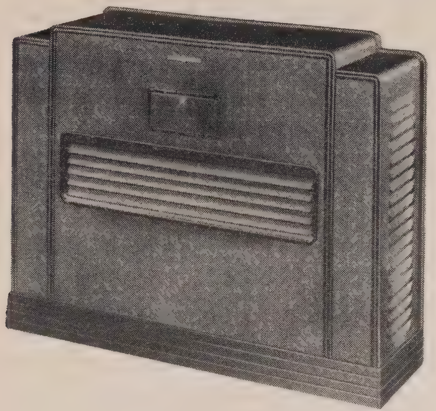


*Fig. 11—G. E. type AD-4 Room Air Conditioner for year round service.*

tical as regards design. This unit is available in several sizes and an exterior view of a typical one is shown in Fig. 11.

These units find their chief application in places where it is desired to air condition several rooms close to each other and where a suitable space is available for mounting the refrigerating unit at some point within a reasonable distance.

The practice of using one refrigerating unit to serve a number of individual room air conditioners is a desirable one, both from the point of view of first cost and operating economy. This practice in no way interferes with the independent operation of the individual units.

### Central Plant Systems

Central plant systems large enough to supply air conditioning for large restaurants, theatres, or complete office buildings, etc., do not lend themselves to a description in a paper of this type. At the present time the equipment required is built up from a number of standard devices, the final assembly of which varies for practically every job, dependent upon the type of application and the size of the load.

The larger manufacturers of air conditioning equipment are, however, well equipped to handle installations of practically any size, and they are rapidly working towards the standardization of the numerous devices that are incorporated in the larger systems.

### Public Acceptance of Commercial Air Conditioning

There is no question that air conditioning has passed the experimental stage and that it is rapidly becoming a commercial necessity. The public has already been taught to look for either complete air conditioning or at least some measure of summer cooling in theatres and restaurants. It is only a question of time before it will look for it in stores and other commercial establishments.

That air conditioning is a profitable investment for commercial establishments is shown by the following extracts condensed from several publications.

An article by Nate S. Shapero, president Cunningham Economical Drug Stores, Detroit, in a recent issue of "Chain Store Age" dealing with the installation of air conditioning in three of this company's drug stores states:—

"The greatest benefits have been realized at the fountains and especially in our food department. Our fountain business in one of these stores has increased somewhat better than 50 per cent. and in the other two, more than 33 per cent. each.

Meanwhile our merchandise sales in all three stores have increased about 15 per cent."

An article, entitled "When Does Air Conditioning Pay?" in the May, 1934, issue of "Restaurant Management," gives a report of a survey made by Ahrens Publications of Air Conditioning in public rooms and restaurants and as this gives some rather interesting figures, a portion of it is quoted below. The method of making the survey was to first send out a questionnaire to fifty typical hotels and restaurants that had air conditioning within the past few years and secondly, to have local correspondents interview managers of air conditioned hotels and restaurants in a number of the larger U.S. cities.

Thirty out of thirty-two restaurants and hotels reported increased patronage as a direct result of air conditioning, ranging from 12 to 100 per cent. The average increase was over 30 per cent.

Thirty-five out of thirty-seven establishments were satisfied that air conditioning is a good investment.

Twenty-two out of twenty-four establishments reported increased check averages ranging from 7½ to 38 per cent. The average increase was 20 per cent.

Operating costs ranged from $1.00 per day to $15.00 per day with an average of $5.00 per day. Most of the systems of the type used for cooling were in use 120 days or more per year.

In April, 1934, Muirhead's Cafeterias Ltd. opened a new, completely air conditioned restaurant on Yonge St., Toronto. Mr. A. S. Tindale, president of this company states that while, of course, they have no figures to show what the business would have been without air conditioning, they are convinced that it has been a definite aid to them in securing business and that it has proved a good investment. This is borne out by the fact that this company now has plans under way for air condition ing their remaining units.

Several years ago the owners of the Imperial Theatre, Yonge St., Toronto, installed air conditioning equipment. Mr. Jack Arthur, manager, states that they feel it was a good investment as it has been the means of improving their summer patronage and turning the theatre into a year round business.

Statements and articles of the foregoing type constantly appearing in Canadian publications and U.S. publications with a Canadian circulation, together with the advertising efforts being put forth by the equipment manufacturers, plus the fact that Canadian users are enthusiastic about their installations, are all tending to make the Canadian merchant more and more conscious of what air conditioning will do for his business. When a merchant installs equipment, his competitor will very shortly follow suit. Nothing prompts a merchant to adopt air conditioning so much as the fact that a competitor is diverting patronage from him.

From the electric utility's point of view, the possibilities of increased load in the business sections of the cities should be encouraging, as by far the biggest percentage of this additional load will be a summer-time one only—surely a fact that brings air conditioning within the realm of desirable business.

# THE BULLETIN

Published by

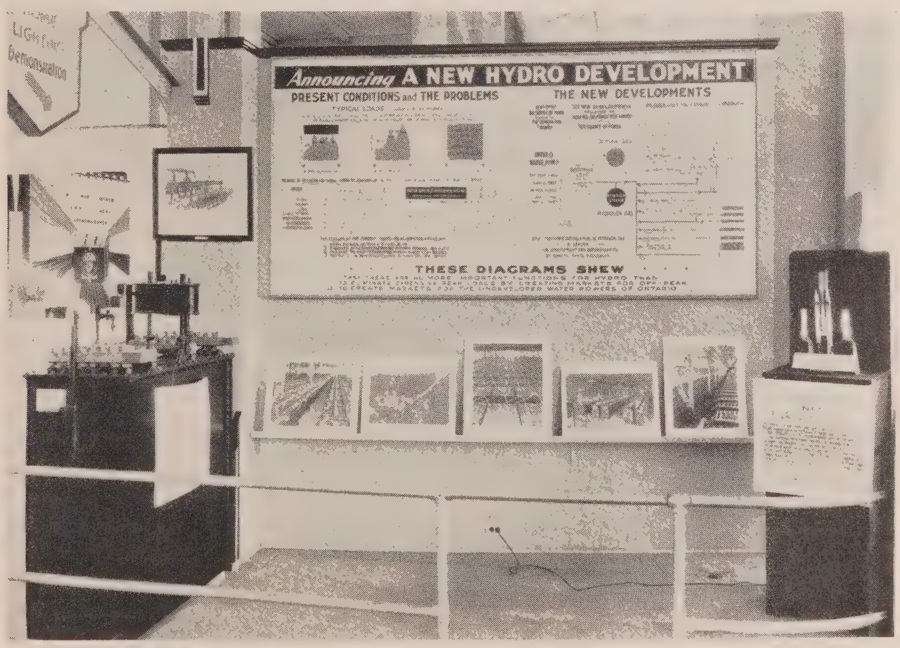
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave. Toronto — Subscription Price $2.00 Per Year

## Hydro Exhibit at the Canadian National Exhibition

THE Hydro-Electric Power Commission contributed to the attractions at the Canadian National Exhibition this year by erecting a rather elaborate display in the Electrical Building.

In the centre of the building, facing the approach from the Automotive Building and from the Coliseum was erected an allegorical display as is depicted on the front cover. The figure of Sir Adam Beck was, through the treatment with lights, reflected periodically as a shadow upon the




*Oxygen and Hydrogen Gas Development Exhibit*

## CONTENTS

**Vol. XXII** **No. 9**

**SEPTEMBER, 1935**



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

background when the sign in front of the display produced the phrase: "The Shadow of a Great Man."

Flood lighting and changing coloured illumination made this central display exceedingly attractive.

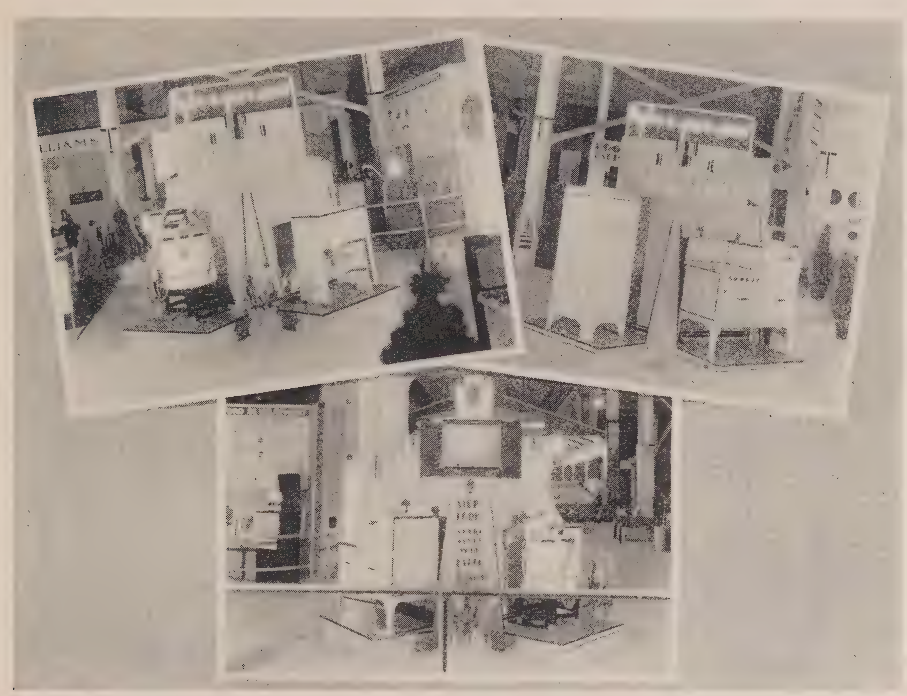
Surrounding the central figure were a number of pedestals and demonstration platforms, some devoted to the display of household electrical equipment and some to the display of electrical farm equipment. On the pedestals all of the manufacturers of all types of major electrical appliances displayed their appliances, the displays being changed periodically to accommodate the number of manufacturers in each particular line of business.

Similarly, on the demonstration platforms, all manufacturers who were able to carry on demonstrations showed how their equipment operated in service.

In each of two pedestals an automatic projection machine projected pictures showing the use of Hydro in all branches of service. There were in all five complete picture stories shown on these two screens:

"The Story of Hydro, Showing all of the Power Plants and Features of the Commission's own System,"

"Hydro on the Farm",

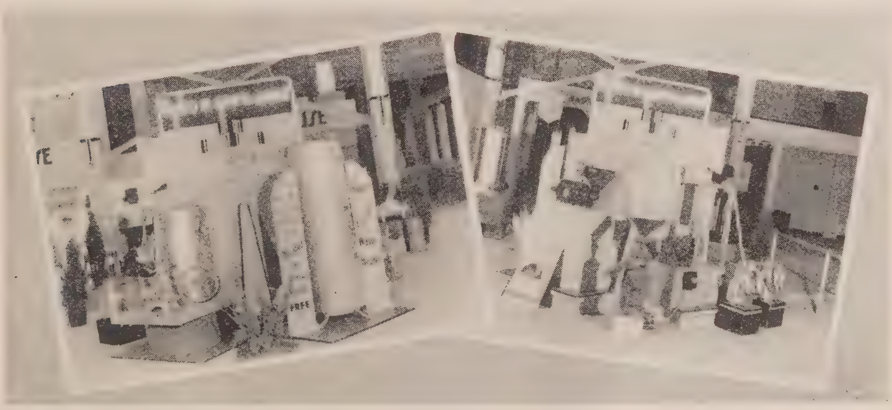


*Views of pedestal exhibiting domestic appliances. (Note the screen for picture display.)*

"Hydro in Industry",
"Hydro in the Home",
"Hydro for Lighting".

Considerable interest was shown by Exhibition visitors in these pictures. The automatic projection machines and the films are to be circulated among Hydro municipalities for general educational purposes.

At the rear of the central display a modern living room was set up showing the effect of proper home illumina-



*Views of pedestal exhibiting rural equipment.*

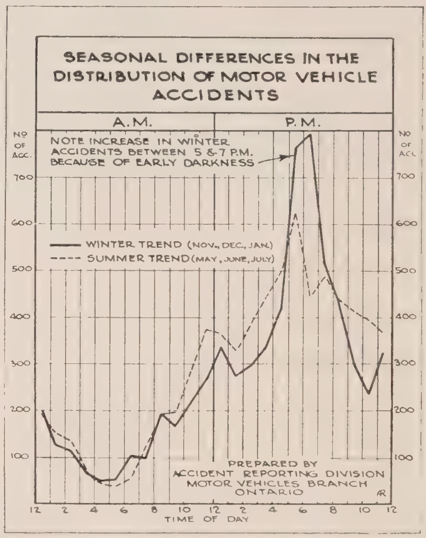
tion. A Home Lighting Expert was in attendance in this living room constantly, to give advice to visitors on home lighting problems.

Part of the display was devoted to an exhibit illustrating the manufacture of oxygen and hydrogen gases by electrical energy.

The co-operation of the Commission with the manufacturers of electrical equipment through the display on this occasion has had a very stimulating effect on the value of the Electrical Building to the exhibitors and to the Exhibition. It is expected that in the near future all manufacturers of electrical equipment will use the Electrical Building to exhibit their products to such an extent that the building will be the most attractive of this most wonderful Exhibition.

# Fall and Winter Driving Hazards

DANGEROUS driving days are still with us. According to the Motor Vehicles Branch, Ontario motor accidents reach their peak during the third quarter of the year, with the fourth quarter, October, November and December, the next most dangerous. City accidents are usually at their highest point during these last three months. Death rates, on the basis of gasoline consumption (vehicle travel), are higher during the last quarter than at any other corresponding time of the year. The rate in November and December of 1934 was 28.2 per ten million gallons of gasoline consumed, as compared with a rate of 21.9 for the whole year and a rate of 25.5 for September, when accidents reached their greatest frequency.




As indicated by the accompanying graph, early darkness and insufficient illumination are largely responsible for the advance during the Winter months.

It is perhaps unnecessary to enlist statistics to show that darkness together with unfavourable weather and road conditions make a bad combination, but a study of 1934 data emphasized this fact. It was found that the share of accidents at night when roads were wet was 101 per cent. higher than the proportion of accidents on wet pavements during daylight. On the other hand, when roadways were snow-covered, giving a background for vehicles and pedestrians, the probability of accident was about the same during daylight

and darkness, but greater during dusk.

The accompanying graph shows the hourly distribution of motor vehicle accidents in Ontario during two three-month periods. Accidents for May, June and July, the months having the longest days; and November, December and January, having the shortest days, are compared.

From 8 a.m. to 5 p.m. and again after 8 p.m. the chart shows Winter accidents to be fewer than Summer accidents. During the intervening hours (5 to 8 p.m.) there is a considerable (33.4%) rise in the number of Winter mishaps. Comparing the hours (9 p.m. to 5 p.m. the next day) during which it is either light or dark in both seasons, the Winter total was about 83 per cent. of the Summer total.

If illumination had no influence on the number of accidents, the same relationship would hold during the hours 6 to 8 p.m. which are light in Summer and dark in Winter.

The expected Winter total for this period would be about 775 (83 per cent. of 934, the Summer total for these hours). However, the Winter total was actually 1,316, or 541 in excess of the expected Winter total. This excess, amounting to 41 per cent. of the Winter total apparently results from insufficient illumination.

There were 10,462 night accidents in Ontario during the last three years. It is safe to assume, then, that about 4,289, or 41 per cent. of the total resulted either directly or indirectly from inadequate illumination.

## An Appreciation

Woodstock, R. 6, Ontario,
August 22, 1935.

H.E.P.C.,
Toronto, Ontario

Dear Sirs:—

Enclosed please find cheque to cover my Hydro bill for the last three months. We are well pleased with the flat rate water heater, which we have used for over a year. The third rate is also very acceptable to us as we are heavy users of power on this farm and will make still greater uses of it at this rate, as it is profitable to us to do so.

Yours truly,
(*Sgd.*) Douglas Hart

The Commission has a great number of rural consumers who express themselves well pleased with their electric service, but rarely put it in writing. Unsolicited letters such as Mr. Hart's are, therefore, always appreciated.—*Editor.*

# Root River Transportation Route

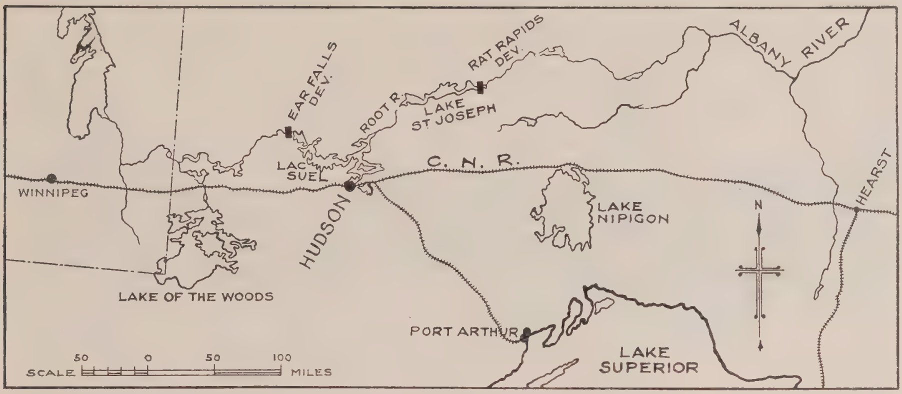
THE Root River Transportation Route provides a means of water transportation between Lac Seul which empties into the English River, flowing westward, and Lake St. Joseph, emptying into the Albany River, flowing towards James Bay. The Root River, which empties into Lac Seul passes a short distance from Lake St. Joseph and in earlier times provided a water passage between the two lakes. The developing of this route for transportation purposes had been discussed for several years, but it did not materialize until the opening of mines near the eastern end of Lake St. Joseph, and the construction of the Rat Rapids development to supply them with power showed the necessity for it. During June of 1934, at the request of the Minister of Lands and Forests of the Province of Ontario, the Hydro-Electric Power Commission carried out a survey of the route and submitted a preliminary report, including an estimate, on the possibilities of the route for the transportation of freight. Following this report and meetings held during July, it was decided to proceed with the work.

When the Hudson's Bay Company began trading up the Albany River from Fort Albany on the James Bay, a hundred and fifty or more years ago, it was by York boats, manned with Indians. From the Albany River these boats passed into Lake St. Joseph and then from a point at the western end of this lake were taken by a half mile portage over the divide between Lake St. Joseph and Lac Seul into Root Creek, a tributary of Root River. This portage was made over a crude form of marine railway which still exists. Logs were laid end to end in two rows, about eight feet apart, over which a car having cast iron wheels about two feet in diameter was run. A York boat was loaded on the car and then with about fifty Indians pulling on tump lines it was dragged over the portage. Down the Root River they passed into Lac Seul and thence on through lakes and rivers to the Lake of the Woods.

With the construction of the dam at Ear Falls, at the outlet of Lac Seul and the consequent raising of the water level of Lac Seul, it became possible to operate a water route into Lac Seul from Hudson on the Canadian National Railway. It only remained necessary therefore to provide means for taking scows up Root River and over the height of land into Lake St. Joseph.

The map shows five natural obstructions on the Root River route between Lac Seul and Lake St. Joseph. Perch Ripple, about 2½ miles above the lower end of the Root River, controlled the reach for eighteen miles upstream to Nattawa portage. By the raising of the Lac Seul water level, Perch Ripple was submerged and the level of the river up to Nattawa portage became that of Lac Seul.

At Nattawa portage a dam was constructed to raise the river for a distance of 6¼ miles back to Lynx portage. The dam at Nattawa portage is a combination earth fill and timber crib structure about 450 feet long with two spillways to pass the



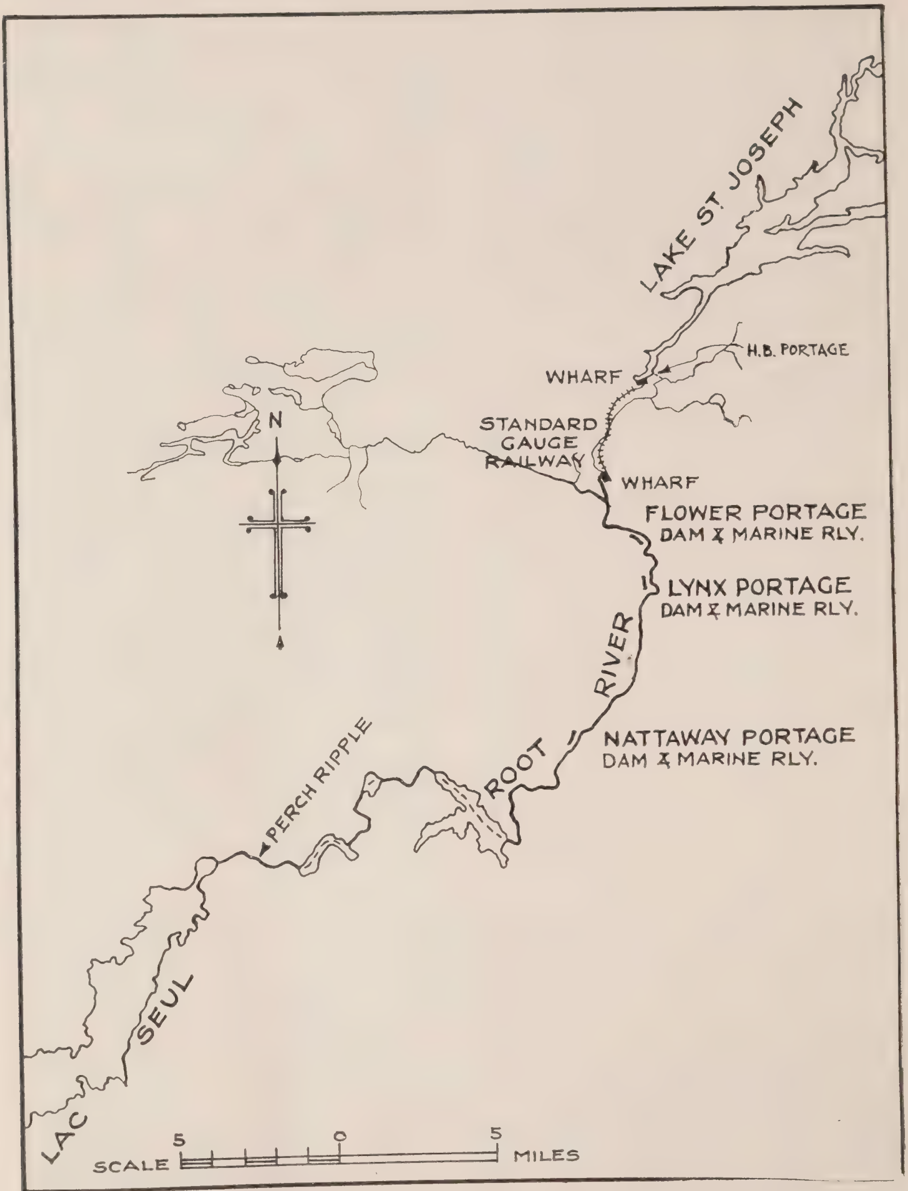

*Map of a section of Northern Ontario showing location of the Root River.*

flood waters. A marine railway about 800 feet long, complete with portage car and properly housed hoisting engine, is located on the west bank with berthing cribs at either end. The track is provided with 85 pound rails at 6 foot centres and a maximum grade of 13 per cent. has been used.

At Lynx portage another dam and marine railway were built. The dam here is in two sections separated by an island. The east branch dam, a timber crib structure, contains two stop-log spillways, while the west branch dam is a timber crib bulkhead section over which the marine railway passes. This marine railway is about 300 feet long, similar in construction to that at Nattawa, and complete with berthing cribs, portage and hoisting engine. The dam at this point raises the river for about 3 miles upstream to Flower portage.

At Flower portage a dam and

*Scow approaching Nattawa portage.*




*Map showing location of the Root River improvements.*

marine railway were again required. This floods back up another three miles into Root Creek. The dam is a combined earth-fill and timber crib structure with a section of free spillway and one stop-log sluice. The marine railway, which is about 500 feet long crosses the dam on the west bank and is also complete with berthing cribs, portage car and hoisting engine.

A standard gauge railway, 3¼ miles

*Nattawa portage site, unimproved.*

long, was built from a point in Root Creek, over the divide between the Lac Seul and the Lake St. Joseph watersheds, the northerly terminus being at Lake St. Joseph level. It is of skeleton track construction with 56-pound rail throughout, having maximum grades of two per cent. north and three per cent. south and maximum curvature of 20 degrees. A wharf is constructed, and a ten-ton, hand-operated derrick is set up at the southerly terminal to facilitate the transfer of freight from scows to the railway. Two flat cars and a thirteen-ton gasoline locomotive are provided to convey material across the railway. At the northerly terminus, a wharf

*Lynx portage, showing marine railway.*

*Flcwer portage, dam and marine railway.*

and derrick are also available to assist transfer of freight from the railway to scows operating on Lake St. Joseph.

It was noted above that the Hudson's Bay portage over the divide between Root Creek and Lake St. Joseph was only about half a mile. Using York boats, they were able to go farther up the stream than is possible with scows, hence the necessity for the $3\frac{1}{4}$ miles of standard gauge railway. The highest point of the Hudson's Bay portage was only about six feet above Lake St. Joseph normal water level and a small dam had to be built here to permit raising Lake St. Joseph level eight feet for the Rat Rapids development.

In addition to the portage railway used by the Hudson's Bay Company, relics were found of dams to control

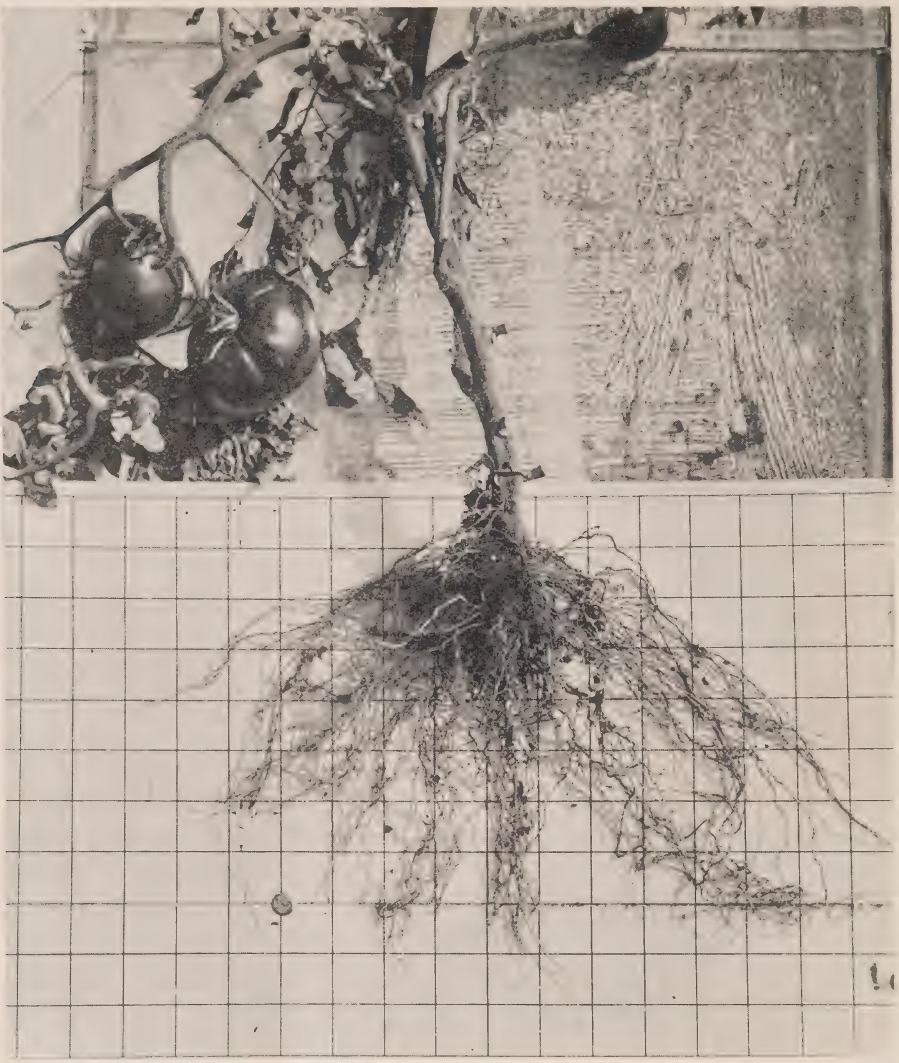
*Root Creek, improved section.*

*Root Creek looking upstream, adjoining standard gauge railway.*

the flow of the Root River and Root Creek to ensure sufficient water to pass the York boats. These dams were formed by rocks placed in the bed of the river at places required, it being supposed that the boats were simply dragged over the tops of the dams after removing the cargo.

Construction work was commenced on August 8th, 1934, and was completed on October 20th. While freight had been accumulating along the marine railways from about October 5th, it was on October 13th that the first through trip was made along the standard gauge railway. Navigation remained open until November 2nd and during that period approximately 500 tons of equipment and supplies destined for the Rat Rapids power development and the Central Patricia and Pickle Crow Mines were taken over the route.

Construction along the transportation route described above was made by the Hydro-Electric Power Commission of Ontario for the Department of Lands and Forests of the Province of Ontario. By this work a convenient means for transporting materials and supplies into the Lake St. Joseph region has been established and will thereby contribute to the development of that otherwise almost inaccessible area of Northern Ontario.



*Above is shown characteristic root development of a tomato plant when electric under-soil heat is used. Note the downward growth and mass of hair roots, leaving surface between rows free for cultivation: with air heating only, the main roots extend horizontally, close to surface for practically their whole length. Plants grown in greenhouses have a root development similar to that of plants grown in the field in warm areas.*

*(See opposite page.)*

# Electric Soil Heating

## for Propagation of Seeds and Promoting Plant Growth

By J. W. Purcell, Assistant Engineer, Hydro-Electric Power Commission of Ontario and Vice-Chairman of the Soil Heating Section of Its Research Committee.

IN the time assigned for this paper, it is only possible to give briefly the interesting features of this work, as well as submit some detail of the results of our observations, much of which will be done by slides of pictures taken on the places of co-operating growers.

Some idea of the effect of under heat as applied by present methods, has been appreciated by growers for a long time, but we find very few who know the soil temperature that is being applied or its differential, that is the maximum and minimum. A few engineers and growers have also known for a long time that underground overloaded electric cables dissipate heat to the earth above them, and a few growers took advantage of this heat for their hotbeds and early crops.

About 1922 an engineer in Norway, a Mr. Jacobson, made deliberate applications of electric energy passed through resistance wire to convert it to heat for promotion of plant growth. These early applications were made in Norway and Sweden, and later in other European countries.

In 1926 electric soil heating was introduced into the United States and by 1932 over a million kilowatt-hours of electric power were known to be used for this purpose. It is reported that in 1933 four times this amount was used, and all this in a country where the energy rates are four or five times higher in cost than here where the prospective user is a Hydro consumer.

We in Ontario, being somewhat more conservative, have been proceeding in an experimental way in co-operation with growers and have made adjustments in rates to encourage this use.

### Advantages

There are many proven advantages from the growers' standpoint, some of them being:

1. The proper soil temperature for any particular crop can be maintained automatically by thermostatic control or reasonably close by manual control.

2. Control of growth within limits at the will of the grower, it being checked or accelerated as desired, often bringing harvest on to meet a market condition.

3. The hotbed can be used in the fall as well as the spring, since constant temperature can be maintained to meet weather conditions, which, of course, is impossible with manure as the heat is highest at the start.

4. Rebuilding of the bed for successive crops is unnecessary; thus there is no time loss between the plantings.

5. The earth used may be selected with due regard to cleanliness and freedom from plant enemies.

6. Uniform distribution of heat is maintained at all times; a feature not true of manure heated beds.

7. For holding plants or hardening them, the adjustment of thermostat to the desired temperature virtually makes a cold frame of the hotbed.

8. Under-soil heat by the electric method can be applied to some field crops to the great advantage of the crop.

### Installations

In the earlier applications of electric soil heat, much stress was made on insulation of hotbeds, propagating benches, etc., to avoid losses. This entailed alterations or rebuilding of existing equipment, which, if in good shape, we now find can be used if the hotbeds and cold frames are free from openings and well banked, or better still, excavated so that the growing area inside is well below the ground level outside. English growers are much in favour of the depressed growing area.

More important than insulation, are the location, shelter and drainage. It is important to have all the sunlight possible, shelter from west, northwest and north winds for which high fences are really not necessary. A sloping fence with an evergreen shield in front may be low and divert the winds over the hotbeds. There should be good draining. Glass should be used in frames, and not cotton covers.

### The Electrical Heater Elements

Resistance heater units of bare wire used to heat the space enclosing them, have been superseded by lead encased insulated resistance wire, except in a very few installations for bench heat. This heater cable is made in sizes to fit conditions, but it is mostly No. 19 Nichrome wire. Sixty feet makes a circuit for 110 volts, and 120 feet one for 220 volts, the former having a load of 400 watts and the latter 800 watts, or 6.7 watts per running foot.

### Temperatures Required and Heat Flux

There seems to be differences of opinion as to the heat requirement for different uses. Table No. 1 following, covering germinating temperatures and time required, as published by Mr. Maurice Nixon, gives some idea of the needs of a few vegetables. In general, plant heat needs may be divided into four steps, viz.:

1—Propagation requires a high heat.

2—Establishing roots, etc.,—for most plants about 10 degrees lower than No. 1.

3—Growing — about 10 degrees lower than No. 2.

4—Tempering or hardening lower than No. 3.

The time of application in these periods varies for plants and with the temperature applied. If lower than maximum temperature, the time will be longer.

The natural daily cycle must be recognized and heat varied accordingly with lower heat at night; also the seasonal cycle is observed in the period applications referred to above. Growing out of natural season, we are actually controlling minimum and

TABLE NO. I

MAXIMUM, MINIMUM AND OPTIMUM GERMINATING TEMPERATURES AND THE CORRESPONDING GERMINATION PERIOD FOR SOME OF THE MORE COMMON VEGETABLES*

| | 1<br>Temperature, lowest-highest in degrees fahr. | 2<br>Corresponding days for germination; highest-lowest days | 3<br>Most suitable temperature; lowest-highest in degrees fahr. | 4<br>Corresponding days of germination; highest-lowest days |
|---|---|---|---|---|
| Radishes....... | 39 – 77 | 23 – 2 | 50 – 59 | 7 – 3 |
| Lettuce........ | 41 – 79 | 20 – 3 | 59 – 68 | 6 – 3 |
| Cauliflower..... | 41 – 77 | 23 – 4 | 50 – 68 | 11 – 4 |
| Peas.......... | 39 – 77 | 25 – 4 | 50 – 68 | 10 – 4 |
| Onions........ | 43 – 79 | 30 – 7 | 54 – 72 | 14 – 8 |
| Parsley........ | 45 – 77 | 35 – 9 | 57 – 72 | 15 – 9 |
| Celery......... | 45 – 82 | 40 – 9 | 57 – 75 | 15 – 9 |
| Beans......... | 52 – 81 | 26 – 3 | 59 – 72 | 10 – 4 |
| Tomatoes...... | 52 – 82 | 25 – 5 | 63 – 75 | 10 – 6 |
| Cucumbers..... | 57 – 82 | 16 – 3 | 72 – 82 | 5 – 3 |
| Cantaloupes.... | 61 – 86 | 20 – 5 | 72 – 82 | 6 – 5 |

* Columns 1 and 2 refer to maximum and minimum temperatures and corresponding average germinating periods, while columns 3 and 4 refer to optimum temperature ranges and corresponding average germination periods.

average temperatures. The maximum is controlled by the sun and weather.

The heat flux to achieve the desired temperatures will vary with the quality of the set-up, heat desired and outside weather conditions. As minima only are being controlled in all the periods referred to above, the requirements for hotbeds are:

TABLE NO. II

| Average outside air at night fahr. | Watts per sq. yd. | Right for months |
|---|---|---|
| 20 degrees | 37.5 | March and April |
| 10 " | 67.5 | November and February |
| — | 100 | December and January |

*Egg plants after setting out in boxes, 7 weeks old—electric heater cables 3 inches below flats, practically 100 per cent. of seeds sown propagated.*

It is assumed, of course, that the space above the growing surface is not too great, as extra space requires extra heat.

For propagating where high heat is needed and the seeds being germinated will only stand small temperature variations, 150 watts per square yard or perhaps more may be required.

### Results Noted

This paper is really a progress report of what we are doing. There have been definite benefits evident to ourselves and the growers with whom we have been co-operating, who are mostly in the Burlington district, as follows:

1. Using under-soil electric heating for the development of plants to set in the field takes about three weeks less time than present methods.

2. Growers report control of the heat as a great advantage, as by this method they can check or accelerate growth at will.

3. Freedom from worry when weather changes.

4. Plants have much greater root development, shorter and thicker stems, and are generally more rugged.

5. When set in the field, plants had less wilt and made quick recovery from it.

### Plants Under Observation Included

In greenhouse benches and hotbeds—propagating seeds of tomatoes, cabbage, cauliflower, egg plant, peppers and some flowers, rooting cuttings of flowers, evergreens and sprouting sweet potatoes.

In hotbeds—first set out of all the above and starting cucumbers and melons.

In cold frames—tomatoes, cabbages, sweet potatoes, etc.

*Egg plant with greenhouse heat only—hot water under the bench. After running for three weeks when 30 per cent. of seed propagated, this flat was removed and set under the bench abandoned.*

In the field—strawberries, cucumbers and leaf lettuce.

### BENEFITS NOTED

So far, all tests under observation have produced results beyond expectation, with a few exceptions where use of the equipment was not fully understood.

Apparently soft and sappy plants or plants that are soft in the earlier stages, are most benefitted. The use of heat for this purpose seems to have a parallel in the use of incubators, viz., for young things more heat is required in the earlier stages and less heat later. In the case of plants there seems to be a definite connection between the heat applied properly at the right time and the root and stock development.

### WATERING

Use of under-soil electric heat increases the water requirements of the plants, and the soil must be kept damp to distribute the heat from the cables. About three or four times the quantity formerly used must be applied.

Tempering the water used is probably a factor in the results obtained, and the quantity that can be used without too great a shock to the plants will depend on the temperature of the water.

Tempering water without soil heat will not achieve the results desired, as can be seen from the chart showing the heat of the soil at varying depths to 12 inches below the surface.

### PICTURES SHOWING RESULTS

1. The exterior of a new type of greenhouse with complete electrical heating, part of the heat, we think, being properly applied to heat the air, and part to the soil below the growing area in the benches.

2. Installing soil-heater cables, thermostats, and for this installation recording equipment, as tests were being made on this set-up.

3. Tomato growth in the above greenhouse.

4. Tomato root development; electric soil heated at the start.

5. Tomatoes—root growth in an air-heated section of the greenhouse.

6. Tomatoes—root growth in same

greenhouse where a steam return pipe three feet below heated the soil.

7. Ageratum—comparison of root and top growth—manure hotbed and electric heated hotbed.

8. Egg plant—comparison of the root and top development.

Nos. 3 and 4—With electric soil heat and under automatic control plus bench heat—7 weeks old.

Nos. 1 and 2—Bench heat only—7 weeks old.

No. 5—Three weeks old with electric soil heat.

No. 6—Three weeks old—bench heat only.

Chart No. 1 shows graphically why a lower air temperature minimum may be used in greenhouses equipped with electric soil heat. Please note the comparison

| | Electric soil heat | No electric soil heat |
|---|---|---|
| Air | 40° | 60° |
| 3 in. below surface | 56° | 53.5 |
| 6 in. " " | 60° | 45° |
| 9 in. " " | 64.5° | about 40° or lower |

Cable 12 in. deep—This can be interpolated for other cable depths and air temperatures.

Moisture content of the soil in electric soil heat test is known as 15 per cent.; for no soil heat it is not known, but it is less than 15 per cent.

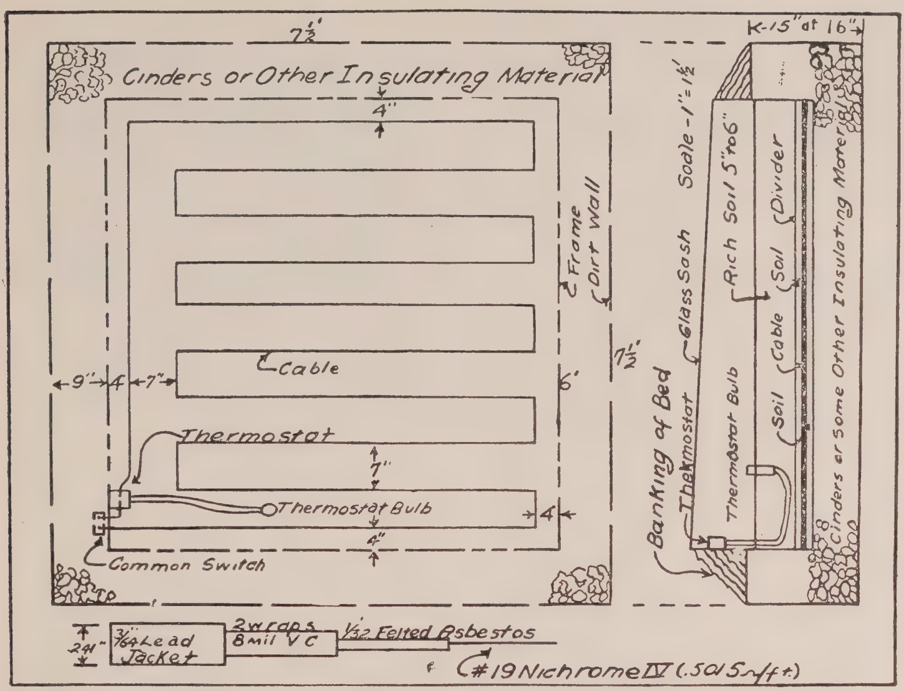
There are about 200 installations of electric soil heat in the province. The largest is about 20 kilowatts capacity, the heat flux varying from 30 watts per square yard to 200 watts per square yard, and the power costs have varied from 30 cents per square yard to about 65 cents per square yard, for spring work only.

With low-rate hydro-electric power available for this purpose, the possibilities of use are great, and in many —I might say most—districts, this form of heat will soon be used by growers in preference to or as an aid to present methods. I might cite the case of one grower for whom we prepared an estimate recently for growing in the greenhouse in the ground. He could profitably use electrical soil heating, and to obtain the same results as at present, he would buy one dollar's worth of electricity and save one and a half dollars' worth of coal, to say nothing of having his present boilers serve another greenhouse in winter, which he cannot use now.

The Commission appreciates very much the co-operation of growers and of the manufacturers of equipment who have assisted in many investigations and applications. We hope this association will in some way establish a means of keeping in close touch with this phase of the application of hydro-electric power.

---

Articles in future issues will report the results of the Commission's Soil Heating Research invesitgations—*Editor.*




*Plan and section of an electrically heated hotbed.*

*(Paper presented to the Ontario Vegetable Growers' Association at Toronto, February 13, 1935.)*

**The International Plowing Match and Farm Machinery Demonstration will be near Caledonia, Haldimand County, Highway No. 6 October 15, 16, 17, and 18, 1935.**

*Interested Consumers should see the Hydro Exhibit.*

# Commercial Electric Cooking Progress

**By Leonard Wells, Power Engineer, Toronto Hydro-Electric System.**

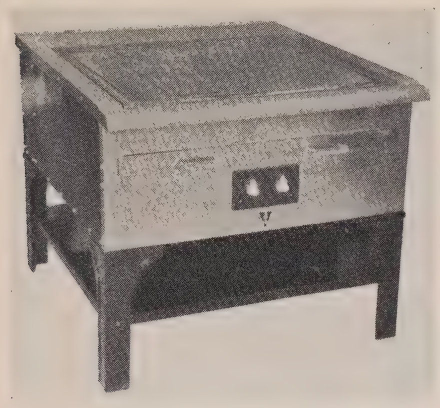
*(Presented to Association of Municipal Electrical Utilities at Bigwin Inn, Muskoka, July 5, 1935.)*

MORE electricity is used today than ever in the modern commercial kitchen. This is not surprising in view of the fact that we are in an age of electrical devices. Conversions of old out-of-date kitchens to electrical operation are a sign of the time and indicate the growing preference of the manager and the chef for up-to-date methods, better service and more satisfactory results. Electricity with its many natural advantages in the supply of perfectly clean and easily controlled heat for cooking purposes is bound to be used in almost every kitchen in the future.

Progress in the commercial field has not been as marked as in the domestic field but this is not surprising because electric utilities, electric dealers and all large stores have been advocating domestic electric equipment for years, but no one appears to have been actively engaged in selling electric commercial cooking equipment. The electric cooking installations that have so far been laid down in Toronto have been either the result of a desire on the part of the parties themselves to use electric equipment or through the efforts of the System in promoting the use of electricity for commercial cooking. Manufacturers of commercial cooking equipment have not yet definitely got around to the electric idea but we believe it will only be a matter of time before they realize that progress demands the electric kitchen. In the meantime it appears that the progress can only be speeded up by the concerted effort of the electric utilities in doing all they can to sell the electric idea, and by seeing that the advantages of electric cooking equipment over other types of cooking equipment are clearly explained to establishments operating commercial kitchens.

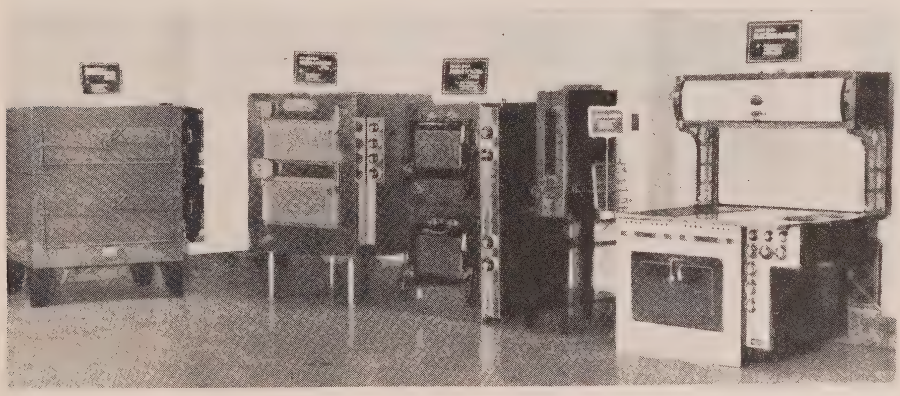
The electric cooking load, due to its characteristics, is considered a very desirable type of load to us in Toronto. Whether the load would be quite so desirable in other municipalities would be a matter for investigation and would possibly depend to a large extent on the relation between cooking load peaks and the local System peak. In order to sell a commercial cooking load, a considerable amount of missionary work is first required. In the first place, it is necessary to SELL THE IDEA of using electricity for commercial cooking and in the second place, the prospect must be advised as to the PROPER TYPE OF EQUIPMENT for his requirements, the cost of same, the WIRING necessary, and the approximate operating cost.

From experience we have found that the first few calls made upon a consumer in regard to interesting him in the idea of electricity for cooking



*Heavy duty electric fry top.*

are generally speaking not very encouraging. Only by repeating the calls and gaining the prospect's confidence is interest in electric cooking equipment likely to be aroused. There is still the old argument to be faced that electricity is too slow for commercial purposes and that the electrical equipment costs too much. In order to combat these arguments we have found that the System's representatives contacting prospects for electric cooking loads must have complete knowledge of the electric cooking equipment available, and be able to discuss its superior points over other types of fuel fired equipment, as well as make recommendations on the type of equipment suitable for the prospect's requirements. It is not enough to point out the advantages of using electric cooking equipment. What must be proved to the prospect is that the electric equipment will do the work with greater efficiency and to much better advantage than any other method of cooking. Sometimes in order to convince the prospect that the electric cooking equipment will do the work as stated, it has been necessary to demonstrate the equipment or install the same on trial. From observations made it would appear that prior to the System going into the matter of electricity for commercial cooking purposes, the majority of chefs and dietitians had little or no knowledge of heavy duty electric cooking equipment, and in fact some of them did not know that heavy duty electric cooking equipment could be secured. However, through the contacts made and the



*Display of heavy duty electric cooking equipment. Toronto Hydro Showroom.*

necessary advertising in restaurant publications, the advantages of the electric equipment have now generally become known. The University and Board of Education have also expressed a desire to co-operate by having suitable electric equipment installed for use in connection with the instruction of students in dietetics. Most of the success in the matter of electric cooking loads so far attained in Toronto may, therefore, be attributed in no small measure to the efforts of the local Hydro System.

As an instance of what it has been necessary to do in order to get some of these loads, I will cite a few examples which are but typical of many others.

On one instance a downtown restaurant consumer, open 24 hours per day, was using a large fuel heated combination urn set at an approximate monthly cost of operation of $35.00. No amount of persuasion would convince the proprietor of this restaurant that electric urn heaters installed under these urns would do the work as satisfactorily or as economically as the method being employed. Unfortunately we knew of no other coffee urn installation of the same size electrically equipped, therefore there was no strong argument in favour of the consumer making an expenditure in an electric installation. As it was desirable from the System's viewpoint that we have information from actual operating conditions on large urns operated electrically, a proposal was made to the owner of this restaurant that the System install the necessary urn heaters for one month on trial. Permission to install these heaters was given on the understanding the owner was in no way

*A recent electric bake oven installaiton in Toronto.*

obligated. At the end of the trial period the necessary information required by the System had been obtained, and in addition the heaters had not only exceeded the restaurant operator's expectations but actually reduced his operation expenditure by $17.00 for the month. Needless to say, after this the urn heaters remained in permanent service. This installation has proved to be so satisfactory, apart from operating cost, that it has been the means of numerous similar installations being made.

In another instance a consumer doing a large volume of business wished to get a large electric fry top but had been informed that such equipment could not be obtained for electric operation. We are pleased to relate that through the co-operation of an electric stove manufacturer the System was able to arrange for this equipment to be made up specially for the consumer's requirements. The element for this top, which was of ten

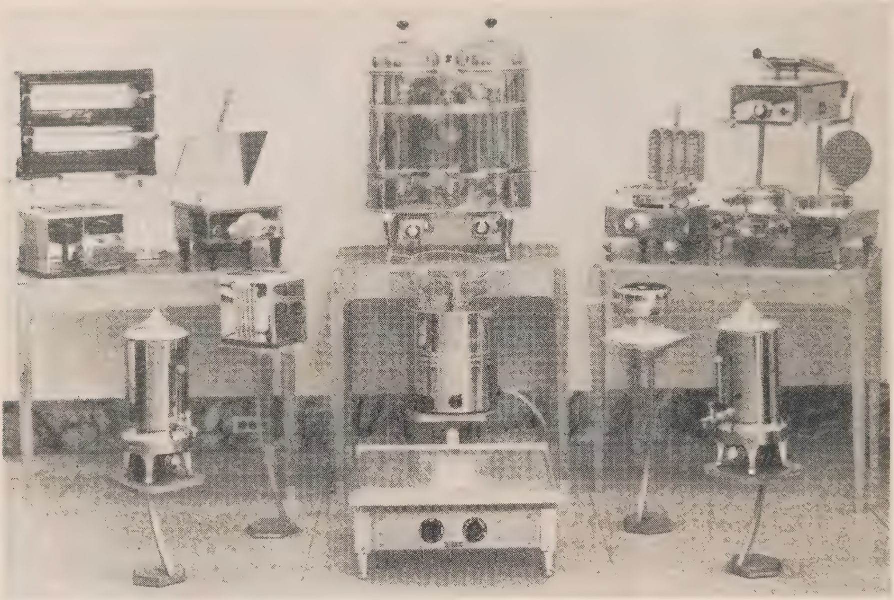
kilowatt capacity, was constructed in two sections and designed so as to give an even distribution of heat over the whole top. On one heat the top is kept at a temperature of approximately 435 deg. fahr., which is understood to be the correct temperature for cooking griddle cakes, frying bacon, liver, etc., or any of the lighter cooking operations. On the other heat the top is maintained at a temperature of 550 deg. fahr. which is the heat suitable for broiling steaks and chops, etc. On account of the volume of business done in this particular restaurant, the grease grooves are exceptionally deep and special provision has been made to keep the grease from getting into the elements or the inside of the equipment where the wiring and switches are located. It is expected that this type of equipment will now become popular with all restaurants serving short orders. The same equipment may also be used as a smooth cooking top if necessary and due to the heavy construction of the top is not subject to sudden variations in temperature. The cast iron top in this instance, which had to be constructed for very severe service, weighs 165 pounds and is understood to be a much heavier top than has ever been built into a range before.

The electric fry kettle is also becoming a very popular piece of electric equipment and with a little sales effort should result in the same being installed in every place where food is cooked in deep fat, due to the advantages of this type of kettle over any other type. One restaurant in Toronto has been using a large electric fry kettle for a number of years and recently replaced a fuel heated fry kettle with another electric fry kettle. It was reported to us that the saving in actual operation, without taking into account the saving in fat, amounted to $20.00 per month when the second fry kettle was installed.

Another downtown restaurant at the System's persuasion installed an electric fry kettle, six kilowatts capacity, holding 45 pounds of fat. This replaced the conventional type of grease kettle heated on the top of a range. The results in this case so far exceeded expectations that orders were immediately placed for additional kettles of the same size for each of the company's other stores. The big saving in this case was in the matter of fat alone which amounted to $26.00 per month in each store. The kettles were also much larger than the old kettles and consequently more and better fry goods could be featured with corresponding increase in business.

Many more examples of this kind could be given but I think I have given enough to show the load possibilities in the commercial electric cooking field.

A satisfactory electric cooking installation will sell many others, therefore it is absolutely essential that the consumer be guided in the matter of purchasing electrical equipment that is suitable for the work required. Satisfactory results cannot be expected if heavy duty equipment is not used where heavy duty equipment is required. This apparently in the past has had something to do with the dissatisfaction of electrical equipment as expressed by some people that it was too slow and that it would not do



*Display of electric counter and pantry equipment. Toronto Hydro Showroom.*

the work. As pointed out previously in this paper, it is necessary in order to sell the idea of commercial electric cooking, that the parties interviewing prospects have knowledge of the electric cooking equipment available, especially when the equipment itself is not available for the prospect to inspect and examine.

The System has found that the heavy duty cooking equipment display in its showroom is one of the greatest helps in this regard. Prospects may be brought in to see the equipment and at the same time it affords a good opportunity of discussing matters in respect to electric cooking, and generally getting the prospect's attention and interest which is not always possible when interviewing a prospect on his own premises. This display does not, by any means, show a complete line of electric cooking equipment but consists of the more essential pieces of equipment, such as baking and roasting ovens, heavy duty electric ranges, hotplates, grills, coffee urns, etc.

After selling the prospect on the idea of cooking electrically and the equipment, it is then usually necessary to sell the necessary wiring installal tion. In the average commercia- establishment where meals are cooked, it is usually found that no more electrical wiring than is absolutely necessary has been installed to take care of ordinary requirements, such as lighting and small electrical appliances. It is, therefore, important when selling electric cooking equipment to see that the matter of suitable wiring is not overlooked.

In spite of the amount of time that it has been necessary to spend in making contacts and selling the idea

of electricity for commercial cooking, the Toronto System during the past year has been responsible for the connecting of 650 kilowatts of commercial cooking load to its lines. This load is made up of electric bake ovens, heavy duty ranges, semi-heavy duty ranges, electric fry kettles, electric coffee urns, steam tables, toasters, and miscellaneous equipment. It is expected that the amount of cooking load obtained during the next year will greatly exceed the above.

# Domestic and Commercial Revenue and Consumption Show Decided Increase During 1934

**By G. J. Mickler, B.A.Sc., Sales Department, H.E.P.C. of Ont.**

IN spite of the severe period of depression through which we have been passing, the revenue and consumption of the domestic and commercial consumers served by Hydro municipalities in the Province of Ontario have been either steadily increasing or holding their own.

Up to 1932 each year showed a marked increase in revenue and consumption, even in the smaller municipalities. It was only in 1933 that this rate of growth was retarded. The 1934 increase was above normal.

For the past number of years figures have been published from year to year to show just what has been taking place in the domestic and commercial fields. Tables have been presented and graphs to illustrate the growth in revenue and consumption as well as other important facts regarding the use of electricity. These figures and graphs have been brought up to date and are presented herewith.

Table No. I gives data for domestic consumers in cities of over 10,000 population, showing the annual revenue, kilowatt-hours consumed, num-

TABLE NO. I

Data for Cities over 10,000 Population

DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 12 | $ 614,925.00 | 12,646,400 | 55,597 | 4.86c | $1.06 | 21.8 |
| 1917 | 19 | 1,063,264.00 | 36,693,100 | 107,248 | 2.89 | .88 | 30.5 |
| 1920 | 21 | 1,926,924.00 | 84,328,000 | 154,186 | 2.29 | 1.11 | 48.4 |
| 1923 | 21 | 3,772,416.00 | 206,266,200 | 223,028 | 1.83 | 1.53 | 83.5 |
| 1926 | 21 | 5,374,069.00 | 324,290,285 | 255,109 | 1.66 | 1.80 | 108.0 |
| 1929 | 26 | 7,530,748.75 | 497,102,897 | 309,645 | 1.51 | 2.08 | 137.2 |
| 1932 | 26 | 8,491,082.70 | 593,618,860 | 323,844 | 1.43 | 2.18 | 152.8 |
| 1933 | 26 | 8,495,321.93 | 595,211,863 | 330,597 | 1.43 | 2.14 | 150.0 |
| 1934 | 26 | 8,847,953.71 | 640,691,529 | 331,120 | 1.38 | 2.23 | 161.2 |

## TABLE NO. II
### Data for Towns over 2,000 Population
DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 19 | $ 90,330.00 | 1,414,500 | 7,410 | 6.38c | $1.11 | 17.4 |
| 1917 | 27 | 180,075.00 | 3,824,600 | 15,731 | 4.71 | 1.01 | 21.4 |
| 1920 | 36 | 353,915.00 | 10,053,100 | 24,041 | 3.50 | 1.26 | 36.0 |
| 1923 | 43 | 651,499.00 | 25,411,300 | 34,135 | 2.56 | 1.57 | 60.1 |
| 1926 | 48 | 1,037,016.00 | 50,487,035 | 47,873 | 2.05 | 1.84 | 89.6 |
| 1929 | 54 | 1,474,547.24 | 68,283,456 | 57,699 | 2.16 | 2.11 | 97.8 |
| 1932 | 59 | 1,595,906.55 | 81,054,613 | 62,843 | 1.97 | 2.11 | 107.5 |
| 1933 | 60 | 1,584,772.57 | 82,321,996 | 63,910 | 1.92 | 2.07 | 107.3 |
| 1934 | 60 | 1,624,571.42 | 86,037,603 | 64,921 | 1.89 | 2.09 | 110.4 |

## TABLE NO. III
### Data for Villages under 2,000 Population
DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 18 | $ 24,913.00 | 291,000 | 1,859 | 8.55c | $1.10 | 13.1 |
| 1917 | 77 | 97,516.00 | 1,412,500 | 8,334 | 6.90 | .96 | 14.0 |
| 1920 | 109 | 233,819.00 | 3,829,900 | 15,665 | 6.00 | 1.29 | 21.2 |
| 1923 | 142 | 531,505.00 | 11,249,100 | 29,689 | 4.72 | 1.59 | 33.7 |
| 1926 | 174 | 942,309.00 | 29,945,632 | 46,900 | 3.15 | 1.71 | 54.4 |
| 1929 | 193 | 1,251,564.03 | 46,755,369 | 57,075 | 2.68 | 1.80 | 67.2 |
| 1932 | 213 | 1,589,233.10 | 66,226,945 | 65,928 | 2.40 | 2.01 | 83.7 |
| 1933 | 214 | 1,559,083.62 | 64,651,543 | 66,371 | 2.41 | 1.96 | 81.2 |
| 1934 | 214 | 1,605,544.56 | 70,803,577 | 67,872 | 2.27 | 1.97 | 86.9 |

## TABLE NO. IV
### All Municipalities Totalled
DOMESTIC SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 49 | $ 730,168.00 | 14,359,100 | 64,866 | 5.08c | $1.06 | 21.0 |
| 1917 | 123 | 1,340,855.00 | 41,930,200 | 131,313 | 3.20 | .91 | 28.6 |
| 1920 | 166 | 2,514,658.00 | 98,211,000 | 193,892 | 2.56 | 1.15 | 44.6 |
| 1923 | 206 | 4,955,420.00 | 242,926,600 | 286,852 | 2.04 | 1.54 | 75.7 |
| 1926 | 243 | 7,353,394.00 | 404,722,959 | 349,882 | 1.81 | 1.79 | 98.4 |
| 1929 | 273 | 10,256,860.02 | 612,141,722 | 424,419 | 1.67 | 2.05 | 122.5 |
| 1932 | 298 | 11,676,222.35 | 740,900,418 | 452,615 | 1.57 | 2.15 | 136.4 |
| 1933 | 300 | 11,639,178.12 | 742,195,402 | 460,878 | 1.57 | 2.10 | 134.2 |
| 1934 | 300 | 12,078,069.69 | 797,532,709 | 463,913 | 1.51 | 2.17 | 143.3 |

ber of consumers, the average cost per kilowatt-hour, the average monthly bill and the average monthly consumption. A study of this Table will show that, as stated above, there has been a steady increase in the revenue and consumption up to the end of 1932. In 1933 there was a slight reduction in the average monthly bill and the average monthly consumption. The 1934 increase in revenue and consumption was above normal.

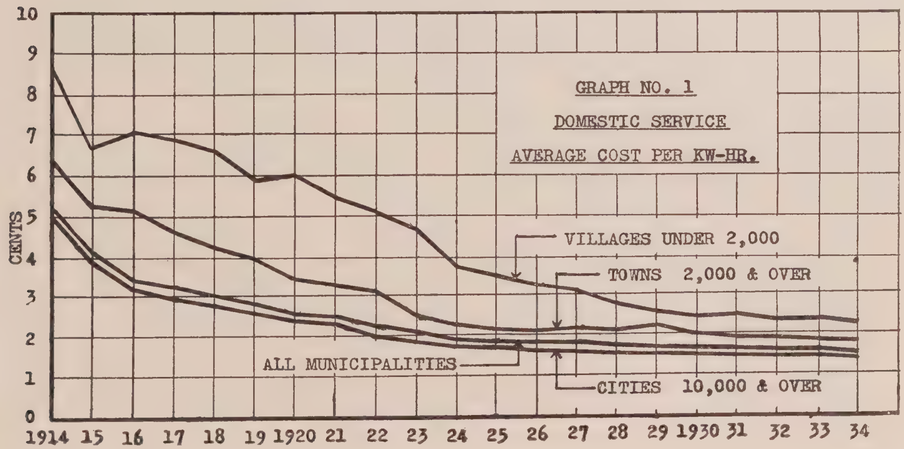
Table No. II gives data for domestic consumers in towns over 2,000 population and in this Table it will be seen that both the revenue and consumption has increased during the year 1934. The averages shown are very encouraging.

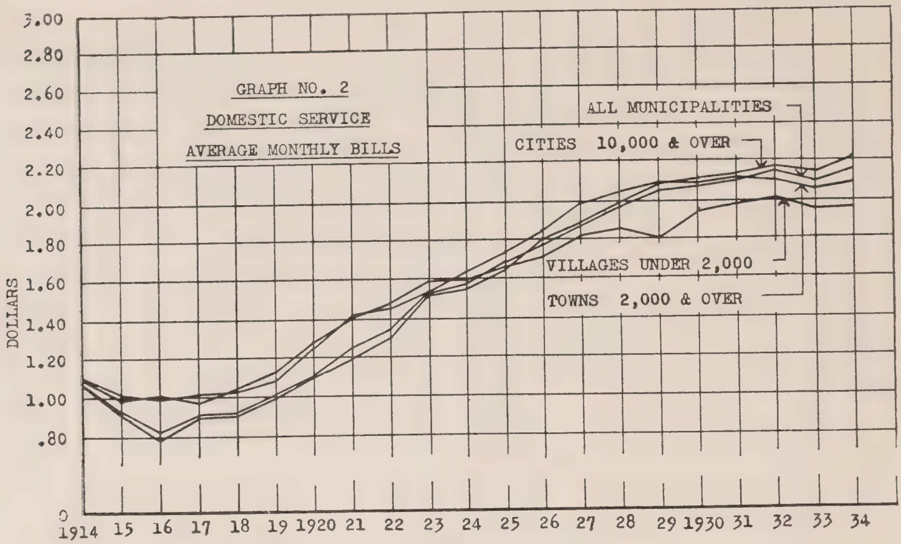
Table No. III gives data for domestic consumers in villages under 2,000 population. In the case of village consumers, both the revenue and the consumption declined in the year 1933 and the average monthly bill and the average monthly consumption did likewise. It is not surprising that this is the case because while in the cities and larger towns there has been some activity in the merchandising field, the loss in consumption and revenue caused by some consumers economizing is offset by the use of new appliances by others; in the smaller municipalities this has not been the case. The merchandising activities in these centres is negligible and the lack of employment has perhaps induced the residents in smaller places to economize more than is necessary in larger places. The increase in 1934 has more than made up for the decline of 1933.

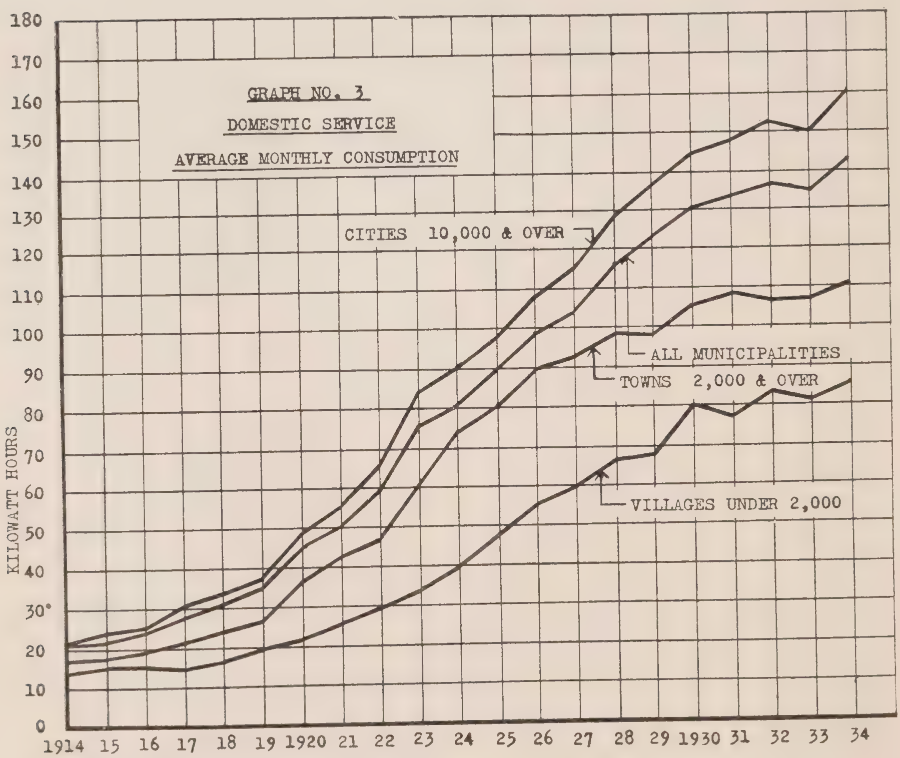
Table No. IV gives data for domestic consumers in all municipalities served by the Hydro-Electric Power Commission of Ontario. The 1934 figure compared with those of previous years show the encouraging results of the Commission's merchandising activities.

It might be interesting to note here that one reason for the fact that domestic consumption has increased is the introduction of the Hydro Flat Rate Water Heater Campaign, the effects of which are now being felt.

One of the outstanding conclusions to be drawn from the figures presented




GRAPH NO. 2
DOMESTIC SERVICE
AVERAGE MONTHLY BILLS
ALL MUNICIPALITIES
CITIES 10,000 & OVER
VILLAGES UNDER 2,000
TOWNS 2,000 & OVER
DOLLARS
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
.80
0
1914 15 16 17 18 19 1920 21 22 23 24 25 26 27 28 29 1930 31 32 33 34


GRAPH NO. 3
DOMESTIC SERVICE
AVERAGE MONTHLY CONSUMPTION
CITIES 10,000 & OVER
ALL MUNICIPALITIES
TOWNS 2,000 & OVER
VILLAGES UNDER 2,000
KILOWATT HOURS
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1914 15 16 17 18 19 1920 21 22 23 24 25 26 27 28 29 1930 31 32 33 34

in these Tables is the fact that while power loads the world over have declined to an alarming degree, since 1930 the use of electricity by domestic consumers has not only shown no decline but has grown steadily, and it seems as though a development of load among domestic consumers is exceedingly desirable if stability is to be maintained.

That there is a vast field awaiting cultivation among domestic users is revealed by the fact that the average monthly consumption among domestic users in Ontario is but 143.3 kilowatt-hours, or 1,720 kilowatt-hours per annum, compared with a possible consumption of nearly 8,000 kilowatt-hours per annum for an average home. The field is apparently only 21.5 per cent. developed.

To further illustrate the effect of time on Hydro development, a few charts are presented which are self explanatory.

Graph No. 1 shows the average cost per kilowatt-hour for each of the four groups which go to make up Tables 1 to 4.

Graph No. 2 shows the gradual growth in the average monthly bills among domestic consumers for the same groups.

Graph No. 3 shows the average monthly consumption per domestic consumer similarly classified.

While the domestic users in Ontario have been doing a good job of holding their position, the commercial lighting users of the province have also shown a wonderful record. It is to be expected with a marked decline in the use of power for lighting purposes in industrial plants for office lighting and other purposes there would be a considerable decrease in the use of electricity by this class of user. As an actual fact, the consumption and revenue produced by commercial consumers in Ontario have not suffered to any serious extent during the last four years.

Table No. V gives data for commercial consumers for cities of over 10,000 population and under the same headings as the Tables for domestic users. In this Table it will be seen that up to 1931 the revenue and consumption

TABLE NO. V

Data for Cities over 10,000 Population

COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 12 | $ 536,350.00 | 14,048,500 | 12,439 | 3.80c | $3.94 | 103.7 |
| 1917 | 19 | 642,989.00 | 27,479,800 | 19,573 | 2.34 | 2.96 | 126.6 |
| 1920 | 21 | 1,103,599.00 | 50,358,000 | 25,505 | 2.19 | 3.77 | 172.0 |
| 1923 | 21 | 2,043,197.00 | 91,146,500 | 32,016 | 2.25 | 5.56 | 246.9 |
| 1926 | 21 | 3,393,186.00 | 147,581,714 | 40,675 | 2.30 | 7.08 | 308.0 |
| 1929 | 26 | 4,772,209.30 | 230,263,364 | 48,713 | 2.07 | 8.49 | 401.5 |
| 1932 | 26 | 5,088,113.49 | 254,512,316 | 51,753 | 2.00 | 8.19 | 409.8 |
| 1933 | 26 | 4,910,798.54 | 242,854,622 | 51,769 | 2.02 | 7.90 | 390.9 |
| 1934 | 26 | 5,078,662.53 | 256,071,970 | 51,118 | 1.98 | 8.28 | 417.5 |

## TABLE NO. VI
### Data for Towns over 2,000 Population
COMMERCIAL LIGHTING SERVICE

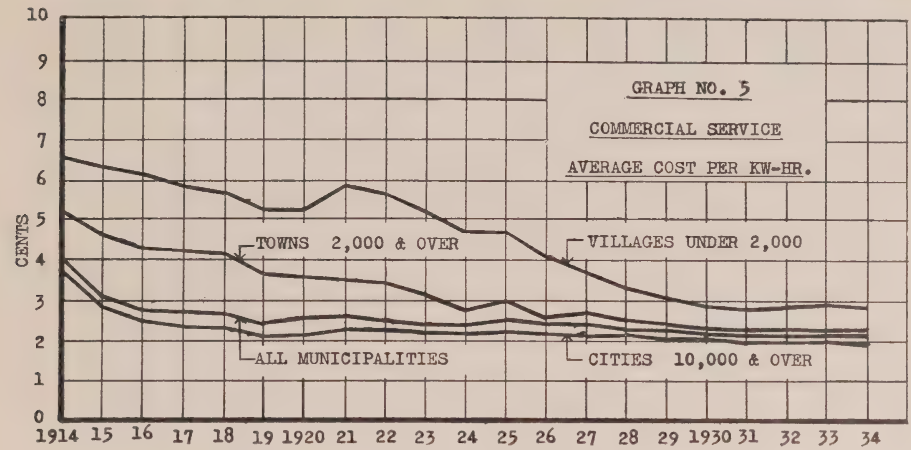
| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 17 | $ 71,457.00 | 1,362,000 | 2,393 | 5.25c | $2.61 | 49.8 |
| 1917 | 27 | 134,730.00 | 3,100,600 | 4,107 | 4.35 | 2.76 | 63.5 |
| 1920 | 36 | 221,867.00 | 6,179,400 | 5,736 | 3.59 | 3.30 | 91.8 |
| 1923 | 43 | 315,530.00 | 9,598,000 | 7,086 | 3.29 | 3.76 | 114.3 |
| 1926 | 48 | 430,467.00 | 15,709,616 | 8,310 | 2.74 | 4.31 | 160.0 |
| 1929 | 54 | 632,010.30 | 26,240,436 | 10,214 | 2.41 | 5.13 | 213.1 |
| 1932 | 59 | 723,774.94 | 31,786,728 | 11,359 | 2.28 | 5.31 | 233.2 |
| 1933 | 60 | 663,596.72 | 29,864,388 | 10,966 | 2.22 | 5.04 | 226.9 |
| 1934 | 60 | 684,126.46 | 30,149,378 | 11,142 | 2.27 | 5.12 | 225.5 |

## TABLE NO. VII
### Data for Villages under 2,000 Population
COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 14 | $ 16,974,00 | 259,200 | 825 | 6.55c | $1.74 | 26.6 |
| 1917 | 77 | 82,756.00 | 1,403,100 | 3,773 | 5.86 | 1.87 | 31.7 |
| 1920 | 109 | 152,497.00 | 2,799,500 | 5,255 | 5.89 | 2.45 | 45.0 |
| 1923 | 142 | 254,530.00 | 4,738,100 | 7,281 | 4.80 | 2.96 | 55.1 |
| 1926 | 173 | 352,942.00 | 8,505,684 | 9,459 | 4.15 | 3.22 | 77.7 |
| 1929 | 193 | 488,997.65 | 15,839,530 | 11,179 | 3.08 | 3.70 | 119.9 |
| 1932 | 213 | 590,994.43 | 20,297,499 | 12,593 | 2.91 | 3.91 | 134.3 |
| 1933 | 214 | 575,396.85 | 19,616,479 | 12,708 | 2.93 | 3.77 | 128.6 |
| 1934 | 214 | 582,132.97 | 20,411,374 | 12,756 | 2.85 | 3.80 | 133.3 |

## TABLE NO. VIII
### All Municipalities Totalled
COMMERCIAL LIGHTING SERVICE

| Year | No. of Munici-palities | Annual Revenue | Kilowatt-Hours Consumed | Number of Con-sumers | Average Cost Per Kw-hr. | Average Monthly Bill | Average Monthly Consumption Kw-hr. |
|---|---|---|---|---|---|---|---|
| 1914 | 43 | $ 624,781.00 | 15,669,700 | 15,657 | 4.00c | $3.63 | 90.8 |
| 1917 | 123 | 860,475.00 | 31,983,500 | 27,453 | 2.69 | 2.77 | 103.1 |
| 1920 | 166 | 1,477,963.00 | 59,336,900 | 36,496 | 2.50 | 3.51 | 140.0 |
| 1923 | 206 | 2,613,257.00 | 105,482,600 | 46,383 | 2.46 | 4.80 | 195.6 |
| 1926 | 242 | 4,176,595.00 | 171,797,014 | 58,444 | 2.43 | 6.08 | 250.0 |
| 1929 | 273 | 5,893,217.25 | 272,343,330 | 70,106 | 2.16 | 7.11 | 328.6 |
| 1932 | 298 | 6,402,882.86 | 306,596,543 | 75,705 | 2.09 | 7.05 | 337.5 |
| 1933 | 300 | 6,149,792.11 | 292,335,489 | 75,443 | 2.10 | 6.79 | 322.9 |
| 1934 | 300 | 6,344,921.96 | 306,632,722 | 75,016 | 2.07 | 7.05 | 340.6 |




increased steadily. The years 1932 and 1933 show a slight decrease, but 1934 was almost equal to 1931.

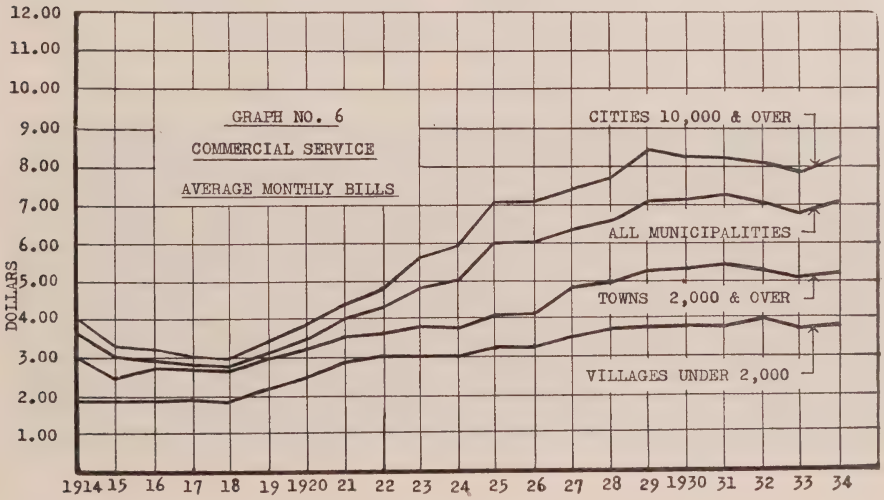
Table No. VI gives similar data for towns over 2,000 population and the same general characteristics apply to this Table as to the previous one, except that the increase carried on into 1932.

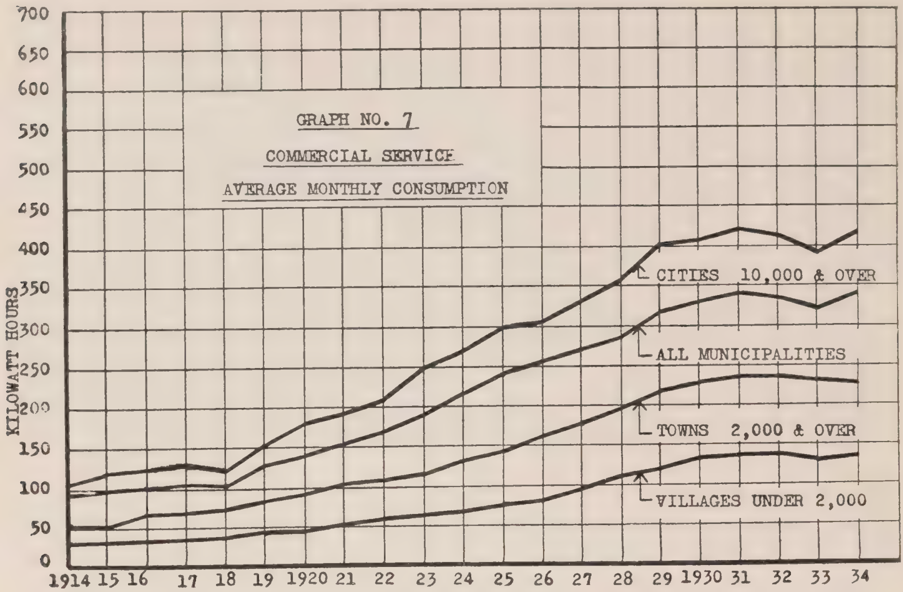
Again, in Table No. VII for villages under 2,000 population the same facts in general apply as in Table No. 6.

In Table No. VIII we see the cumulative effect of the depression on commercial consumers. It is interesting indeed to see that up until 1932 both consumption and revenue increased, and it was only in 1933 that any decrease in either of these items showed itself, and 1934 recovered practically all lost ground.

The figures on commercial lighting contained in these Tables are also graphically illustrated in graphs Nos. 5, 6 and 7.

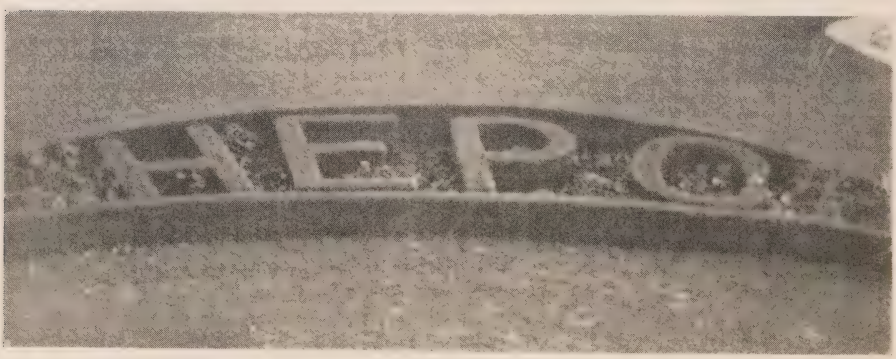
There is no yardstick by which the






possible consumption among commercial consumers can be measured or gauged, so that it is difficult to tell to what extent this field has yet to be developed. Suffice it is to say that remarkable progress has been made in the past few years in the art of illumination and that the lighting installations of many commercial users are woefully inadequate to meet their needs, both for safety and health of employees.

The interest shown in the Lighting School and the numerous inquiries received by the lighting trade make it safe to say that a marked improvement in store lighting, factory and office lighting will manifest itself with corresponding increase in commercial lighting consumption and revenue among Hydro users.



THE
BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year

# Memorial to D. B. Detweiler Unveiled

ON Thanksgiving Day, October 24, 1935, the memory of a Hydro pioneer was honoured, when at his birthplace at Roseville, in Waterloo County, Ontario, a cairn was unveiled dedicated to the memory of the late Daniel B. Detweiler. It was the late Mr. Detweiler who first fostered the idea which was later developed and carried out under the direction of Sir Adam Beck, viz.: the Ontario Hydro System.

During the later years of the nineteenth century such progress had been made in the generation and long distance transmission of electricity that the public of Ontario began to show a lively interest in it, looking to the possibility of obtaining power from large generating plants being established at Niagara Falls.

In 1898 Daniel B. Detweiler, a manufacturer in Berlin (now Kitchener), Ontario, conceived the idea of bringing Niagara power to the towns in the mid-western part of old Ontario, and being satisfied that great benefits would result if it could be done, made it a subject for discussion on every opportunity. The first authoritative move towards obtaining power from Niagara Falls was in 1900 when the Toronto Board of Trade, at its meeting on the 25th of April, appointed a committee to make an investigation and report. The studies made by that committee had specific reference to the needs of Toronto, and the report submitted suggested that the hope for cheaper power was to bring current from one of the great Niagara generating plants. It also raised the question whether or not Toronto, as a city, should control the proposed Niagara power connection that the Toronto Electric Light Company was contemplating at that time.

At the annual banquet of the Waterloo Board of Trade, held on the evening of February 11, 1902, E. W. B. Snider of St. Jacobs was the principal speaker. Mr. Detweiler had often discussed his idea of bringing power from Niagara Falls with Mr. Snider, and in his address Mr. Snider advocated that "steps be taken to secure more industries of diversified character, and also that a committee

## CONTENTS

Vol. XXII No. 10
OCTOBER, 1935



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

of men from Berlin, Waterloo, Guelph and Galt be formed to take up the question of bringing motive power from Niagara Falls into that district." "He (Mr. Snider) was of opinion that as Toronto was discussing the utilization of power from Niagara Falls, Waterloo should seek the co-operation of Boards of Trade of Berlin, Galt and Guelph and the Mayors of Preston and Hespeler, to investigate the matter. If Waterloo could offer cheap power to manufacturers, it would greatly assist in its future progress."

There was no further action on the matter, beyond discussion, until May 8, 1902, when at a meeting of the Council of the Berlin Board of Trade, the Vice-President, Daniel B. Detweiler, introduced among other matters "the advisability of appointing a committee from different inland towns, to take what steps they can to secure power from Niagara Falls." "Mr. Detweiler believed that figures could be secured to convince manufacturers that it is a good thing, and that by the municipalities working together something could be accomplished." It is further reported that "Several gentlemen refused to go on such a Committee, but Mr. Detweiler and Mr. Snider were appointed to prepare a resolution dealing with the matter."

On the day following this meeting, Mr. Detweiler wrote to Charles H. Mitchell (of the firm of C. H. & P. H. Mitchell, Hydraulic and Electrical Engineers, Toronto) asking him to come to a meeting of manufacturers being arranged, for the purpose of giving information towards placing the question before its members. Mr. Detweiler then made a tour of mid-western Ontario, travelling by bicycle on his own time and at his own expense. It is not known how many places he visited, but they extended from Guelph and Brantford on the east to London and Stratford on the west. His story was so impressive and his earnestness so apparent that that long trip secured many followers who were willing to join in with him.

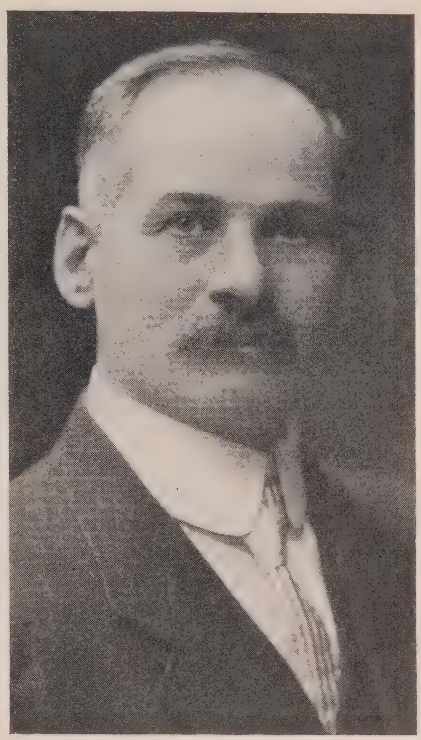
Mr. Mitchell replied, stating that he was willing to attend a meeting as suggested by Mr. Detweiler, so, Monday, June 9th, was fixed as the day. This took the form of a banquet at the Walper House in Berlin

which was attended by representatives from Toronto, Galt, Guelph and a number of the surrounding towns. A subscription list to collect funds "To defray expenses incurred by the Engineer's (Mr. Mitchell) services and the cost of providing lunch for outside representatives" raised the sum of Forty-five Dollars from twenty-five subscribers. E. W. B. Snider was appointed Chairman of the meeting and Mr. Detweiler, Secretary. The chief speaker was Alderman F. S. Spence of Toronto.

A month later, on July 9, 1902, a second meeting was held at Berlin when the matter was again taken up by the municipal representatives. At this meeting E. W. B. Snider, D. B. Detweiler and F. S. Spence were appointed a Committee to obtain information.

The subject of Niagara power had continued to be agitated in the towns and villages represented at the Berlin Conferences. In the case of Toronto there was a strong movement in favour of obtaining a transmission line direct to Toronto for the purpose of that city alone and in January, 1903, the city made application to the Legislature of Ontario for the right to generate and transmit Niagara Falls power for the uses of the city. This application was refused by the Government on the ground that the city had no matured plan for exercising the powers asked for. The City of Toronto now threw in its lot unreservedly with the other civic bodies.

The Committee appointed at the meeting of July 9 prepared a report which was read at a meeting at

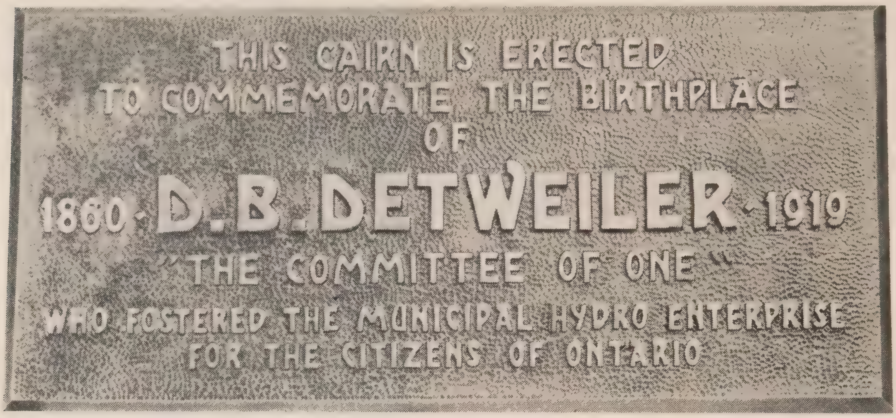


*Daniel B. Detweiler*
*1860 - 1919*
*"The Committee of One"*

Berlin on February 17, 1903, which was attended by about 90 municipal and manufacturing representatives. "The report recommended that prompt action be taken to obtain from the Legislature, powers enabling municipalities to purchase and sell power, and to co-operate, to develop and transmit or distribute electrical energy, or to buy power and to sell and distribute the same to the several municipalities."

After discussion of the report the following motion was submitted.

"That we respectfully suggest and urge upon the Government of Ontario the advisability of the Government




*Bronze plaque on the cairn.*

building and operating, as a Government work, lines for the transmission of electricity from Niagara Falls to the towns and cities of Ontario, or that they extend the powers of the present Niagara Falls Park Commission so that they may as a public work build and operate the necessary lines to transmit electric energy from Niagara Falls, and that for this purpose they be empowered to issue debentures which might be guaranteed by the Government, but which would be eventually paid out of the receipts from the sale of electrical energy, thus entailing no charge upon the Provincial funds, and that the municipalities here represented call their representatives in the Legislature to urge upon the Government to carry out this resolution."

This was subsequently amended by leaving out all reference to the Park Commissioners.

As a result of the meeting held in Berlin on February 17, 1903, a large delegation representing all the municipalities which had become interested in the movement, was assembled at the Parliament Buildings in Toronto on February 27th. After presenting their demands to the Premier, he promised that a bill would be introduced forming a Commission which would proceed along the lines suggested, in purchasing and distributing power. Such a bill was passed June 12, 1903, viz.: "An Act to provide for the Construction of Municipal Power Works and the Transmission, Distribution and Supply of Electrical and other Power and Energy" (Chapter 25, 3 Edward VII, 1903).

According to the provisions of this Act the Ontario Power Commission was appointed, consisting of E. W. B. Snider, St. Jacobs (Chairman); P. W. Ellis, Toronto (Vice-Chairman and Treasurer); W. F. Cockshutt, Brantford; The Honourable Adam Beck, London, and Professor R. A. Fessenden, Washington, D.C. Under the date of March 28, 1906, this Commission presented a report which was made the basis of action by the Hydro-Electric Power Commission of

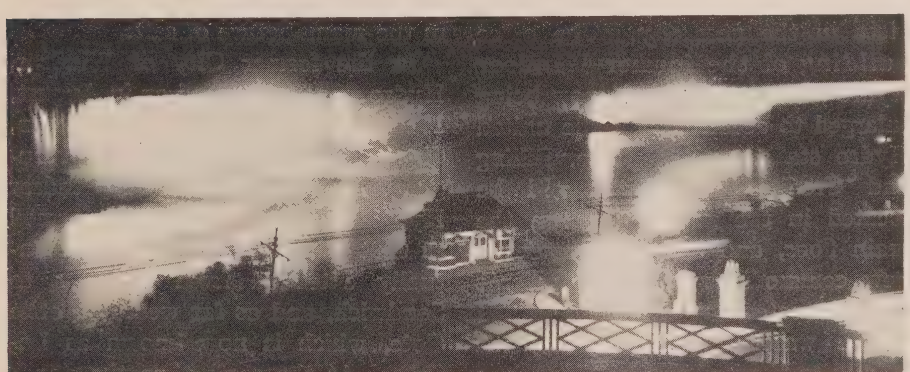
Ontario, which was formed under an Act passed on May 14, 1906.

Power from Niagara Falls was first turned on on October 11, 1910, the opening ceremonies being at Berlin, where Mr. Detweiler lived and first advanced his ideas, and as a "Committee of One" paved the way towards definite action. To mark the completion of 25 years of successful operation of the Hydro system, it is therefore fitting that honour be given to the memory of the man who, having conceived the idea of bringing power from Niagara Falls for general distribution, had the courage and conviction that it could be done, and was able to build up a nucleous from which he saw the Hydro System eventually take form and grow into an organization extending far beyond his fondest hope.

The memorial which is a Georgetown cut stone pile was unveiled by Mrs. Detweiler, his widow. At the moment of the unveiling a daughter of Mr. Detweiler, Mrs. O A. McLean, turned on an electric memorial light at the intersection of the highway immediately opposite the cairn. At the conclusion of the ceremony, August R. Lang presented Mrs. Detweiler with a substantial purse on behalf of the Cairn committee. Mayor J. Albert Smith of Kitchener presided as Chairman. Tribute was paid to the memory of Mr. Detweiler by T. Stewart Lyon, Chairman of the Hydro-Electric Power Commission of Ontario, and there were also addresses by Alex. M. Edwards, M.P. for South Waterloo, and Dr. J. D. Detweiler of the University of Western Ontario. The devotional exercises were conducted by Rev. George Fleming and Rev. L. H. Wagner, both of Roseville. Approximately 300 people were present to witness the unveiling ceremonies.

* * * *

Acknowledgement is made for information given, to A. R. Lang of Kitchener, Ontario; Genesis of the Power Movement by H. E. P. C. of Ontario; Report by James Mitchell, Ontario Representative, Public Archives of Canada, December 7, 1918; Hydro-Electric Development in Ontario, by E. B. Biggar, 1920; and Incidents During Early Days of Hydro, by T. J. Hannigan, THE BULLETIN, July, 1934.



# Windsor Public Utilities

### By W. A. Shaw, Lighting and Assistant Engineer, Windsor Hydro-Electric System

BY an Amalgamation Act, passed by the Provincial Government this year, the four municipalities of Sandwich, Windsor, Walkerville and East Windsor were united to form a new city called "Windsor". The new city has a population in excess of 100,000 people, and it thus becomes the fourth largest city in the Province.

The Windsor Utilities Commission was created by the recent Amalgamation Act. The management, control and operation of the undertakings of the Essex Border Utilities Commission, the Waterworks Systems, the Hydro-Electric Systems of the amalgamated municipalities, the Metropolitan Hospital and the Board of Health, were vested in the Windsor Utilities Commission. J. Clark Keith, formerly Engineer of the Essex Border Utilities Commission, is General Manager of the new Windsor Utilities Commission.

Under the Utilities Commission, we have the Windsor Hydro-Electric System with O. M. Perry as Manager, having control over all Hydro services in the new city. The office building of the former Windsor Hydro-Electric System is now being enlarged to accommodate the united Hydro staffs. The Service, Billing and Credit Departments will be located in the new section on the main floor, and in the basement a new commodious vault for records will be located.

The waterworks staff has been moved to the building of the former Walkerville Hydro-Electric System from the Windsor City Hall.

The early history of Hydro would not be complete without some mention being made of the street railway and the early lighting and power companies.

In 1888 direct current was supplied from a saw mill on Sandwich St. near Dougall Ave., for the first electric street cars on urban streets in Canada. These cars ran along Sandwich St. from the British American Hotel to Walkerville.

A few years later, the Sandwich, Windsor and Amherstburg Railway Company installed a more modern plant on the site of the present car barns and in 1907 this same company found it necessary, on account of the growth of the community, to establish a larger plant on the property of the Canadian Salt Co. This plant supplied direct current for the street railway as well as 60 cycle for lighting and power. High pressure steam was purchased from the Canadian Salt Co. to drive the generators and the exhaust steam was returned for use in the manufacture of salt.

In the former City of Windsor, Hydro was first turned on in August, 1914, when the late Hydro Chairman, Sir Adam Beck, was here to inaugurate the System. The Windsor Hydro-Electric System was formed at that time, and service was eventually extended from Windsor to Sandwich, and as far west as Petite Cote, which is now known as LaSalle. At the same time the Sand-

wich, Windsor and Amherstburg Railway Co. supplied 60 cycle lighting and power to these towns and also operated the street railway system.

In the spring of 1920, the Sandwich, Windsor and Amherstburg Railway Co. lighting and power system was purchased by the Windsor Hydro-Electric System, and gradually the 60 cycle consumers taken over with this system were changed over to Hydro, until finally in March, 1927, it was completely absorbed by the Hydro System, and the plant was dismantled.

The town of Sandwich in 1924 decided to operate its own system, and the Hydro plant and equipment within the town limits was purchased and its operation entrusted to the Sandwich Hydro-Electric System. This system continued as a separate unit until the recent Amalgamation Act came into force.

In the Walkerville section, the first light and power was distributed by the Walkerville Light and Power Co., a subsidiary of Hiram Walker & Sons, who supplied 60 cycle power from their own power plant. It is interesting to note that the Walkerville Light and Power Co. originated by the Walker interests supplying a few of their officials with light and power; and then by gradually adding more and more consumers outside of the Company, the Walkerville Light and Power Co. was formed to take care of these consumers.

The Walkerville Hydro-Electric System was formed in the year 1914, and Hydro power was turned on in August, 1914. This System purchased the lines and equipment of the Walkerville Light and Power Co. and changed over the 60 cycle consumers to Hydro.

In the year 1915, the lines were extended east as far as the old villages of Tecumseh and St. Clair Beach. This continued as part of the Walkerville System until the year 1922, when Ford City (East Windsor), Riverside, Tecumseh and the village of St. Clair Beach were incorporated. These Municipalities at this time in 1922 organized their own local Hydro systems, and purchased from the Walkerville System the Hydro plant and equipment lying within their boundaries. The Walkerville Hydro operated these five separate systems.

The new City of Windsor will have about 27,000 consumers, with an average yearly load of approximately 33,000 horsepower on the eight substations strategically located in different sections of the city.

In this section of the Province, Hydro has always been used very extensively by the domestic consumer. In 1915, the average monthly consumption was only about 15 kw-hr., while in 1927, it had risen to about 190 kw-hr. Due to later difficult conditions, this average dropped slightly. It is also interesting to note that in 1915 the average cost to the consumer was about 5c. per kw-hr., while in later years it dropped to less than one and three-quarter cents.

The new Windsor Hydro-Electric System will maintain a Load Building Department which is primarily interested in the placing of more electrical appliances in the homes, with a view to the increased use of Hydro power.

With greater interest being shown in range, water heater and Better

Light activities, it is felt that the Windsor Hydro-Electric System will do much to increase the future use of Hydro power in this section of the Province.

The operation of the new Windsor Utilities Commission should be very satisfactory and efficient, as a great deal of duplication in former services is being done away with, by the union of these former separate municipalities.

# Building Foremen to Appreciate Accident Prevention

**By C. J. Rutland, Director of Safety, Texas Power and Light Company, Dallas, Texas**

YEARS ago the industrial safety movement accepted as one of its principal foundation stones, the practical theory that the foreman is an important key to the success of the accident prevention program. Those organizations which through the years have builded on and expanded this theory, have achieved definite results in accident reduction, improved efficiency, better employee morale and greater discipline. It is a demonstrated fact that if a workman is carefully selected for a position and then thoroughly trained so every job that he does is performed exactly 100 per cent. right, the perfect safety answer is nearly obtained—the job is performed in an efficient manner, no one is injured and no money is spent for wasteful accidents. A workman gets hurt only when he does something wrong. The foreman is the one person to eliminate wrong habits. He is the key man to teach safe habits and efficient work to his men.

In all successful accident prevention work, the above facts are held paramount and are never side-stepped.

Building foremen to appreciate accident prevention work is just as essential as providing them with blue prints and manuals to install equipment, to build and maintain lines or as issuing instructions to them regarding the selection of workmen for jobs. The prime objective is to make the foreman safety-minded and deeply concerned about accidents, their causes and costs, in order that when one does occur he will automatically analyze the causes and ask: was I responsible in any degree for the cause of this accident; was the injured the right man to put on this job; was I sure of his qualfications; did I know he had previously been using this unsafe practice; what was his attitude about respecting my instructions; did I train this man to do the job in the right way?

The foreman's boss and the Safety Engineer are the two persons who can bring about this attitude of mind. The foreman can prevent accidents if he really wants to and if his boss

makes it clear that he, too, demands a no-accident record.

How can this attitude be created? Different companies approach the objective from different angles. Certainly the head of the department or the superintendent over the foreman must reflect his executive viewpoint and interest in safe operating practices. The superintendent in most cases determines what work is to be carried out, not the workman; he, not the employee, decides where a line is to be built or where installation is to be made; he selects the kind of material to be used; he designates the rate of pay which shall prevail; he determines how many men are to be employed on the job and decides practically all policy matters dealing with employee and employer. All of these basic principles are under the control of the superintendent, and if he wishes to inculcate in the foreman the principles and habits of safe practices, he must discharge his own responsibility first. Each foreman must eventually be convinced so there remains no doubt in his mind as to how "the big boss" feels about an accident. If the boss is sincere in his own safety-mindedness, the safety answer will be obtained. If he is not, the successful answer will not be forthcoming. If he is sincere he will demostrate by many ways his executive interest. He will place safety at the head of the list of subjects at the foremen's meetings. He will authorize reasonable expenditures for safety. He will readily notice dangerous conditions and safety improvements on his general visits of inspection. He will observe the unsafe practices of workmen and immediately summon the foreman and require their correction. He will exhibit a personal interest in the general provisions for medical treatment and compensation. He will not be indifferent to employees' losses and sufferings. He will demand strict discipline in the execution of company orders.

If a serious accident occurs, a rigid investigation is made and the fundamental causes determined. The facts are presented to the superintendent who calls in the foreman and reprimands him, if there has been negligence in his leadership or method of supervision of the work. He demands disciplinary measures, if there has been a violation of rules, poor judgment, haste, failure to inspect, or other unsafe practices.

Parallel to this line of emphasis on accident prevention, the safety engineer approaches the goal of foreman interest by the use of a little different vehicle. He is the adviser, the stimulator, the developer. He becomes the friend of the foreman. His educational plan is to point out that safety and efficient production are one and the same—accidents and efficiency cannot exist in the same crew. He reflects that accidents which cause physical injury and medical bills are no different from accidents that cause damage to equipment and interruption to service. He stresses the truth that if a foreman, who is put in charge of men, cannot regulate their operating practices, he cannot be expected to efficiently handle production and assume responsibility for the care of expensive equipment placed in his charge. He touches the emotional side of

the foreman when he pictures the moral obligation to his men, what a serious accident means to the foreman's own pocket book, depleted by unusual expenses; his job endangered by the advent of a new man; his home life torn by the tragedy of an accident, and his own physical body suffering from pain and worry. He emphasizes the fact that the foreman is placed in his position because he is supposed to possess a greater knowledge of the operation of the business than the man whose work he supervises; he is responsible for the safety of his men and must create respect and dignity for his rules and instructions. He teaches first aid and resuscitation, and stimulates the foreman's enthusiasm to keep this at a high interest among his men. He investigates accidents in the presence of the foreman and completely unfolds the fundamental causes, many of which immediately suggest remedies to the foremen. He periodically publishes accident reports, showing the relative standing of foremen, the number of men under each, hours worked, lost time accidents, days lost, the fundamental causes and total cost. He helps the foreman with safety meetings of employees, counsels with him concerning safety committees, advises on all phases of accident prevention work, but carefully avoids assuming any of the duties rightfully the function of the foreman, such as actual regular inspections, the issuance of specific instructions to workmen, training them in safe habits and exercising disciplinary measures. He continually reflects to the foreman that accidents are not inherent in the operation of the business; that they can be controlled and their prevention is just as vital a part of the foreman's duties as any other phase of his work.

What is the psychology of this type of continued, driving interest in accident prevention reflected by the department head and the safety engineer; What is the foreman's reaction? He is sold on it; he is convinced without any doubt left in his mind, that the boss means business. He knows an accident doesn't just happen; that there is a fundamental, preventable reason behind its occurence. He definitely recognizes that his company holds him responsible, not only for getting the job done efficiently, but getting it done without injury or the waste of money caused by a preventable accident.—*Edison Electric Institute Bulletin.*

# Standardization of Line Material and Construction

A RECENT issue of ELECTRIC LIGHT AND POWER contains an article by Howard P. Seelye, Detroit Edison Company, under the above title. Space will not permit reproducing it in full, but the following has been extracted from it to enable such of our readers who have not been privileged to read the original, to profit by some of the suggestions.

Practices in line construction grew up largely by the method of trial and error rather than technical engineering study. In general, the structures are rather simple and could be built to answer the purpose satisfactorily without a great deal of preliminary design. The construction man found that certain sizes of poles, crossarms, bolts, etc., answered his purpose and continued to use them unless something went wrong, whereupon he changed to some other size which, in his opinion, would be better. This method was simple and satisfactory as long as companies were small, structures few, and construction organizations simple. Difficulties arose, however, when distribution systems expanded to larger areas, and materials were brought in larger quantities. The trouble was that the construction men in any one company did not agree among themselves as to the proper methods, and agreed even less with men of other companies. The result was that a great variety of materials and methods of construction were established among different companies, and even in any one company unless definite standardization work had been done. The material manufacturers were called upon to furnish all this variety of materials; store rooms of the operating companies were clogged with an excessive amount of stock; and confusion existed among the construction men of any large organization when each different crew had its own special way of building lines.

The cure for this is, of course, the establishment of definite standards of materials, structures, and construction methods, first in the individual company, and then as far as feasible, between companies throughout the country. An ideal condition, perhaps, would be one set of standards for all, but that is impracticable under the variety of local requirements and conditions, of engineering ideas, and of managements which exist. The most important step is the thorough standardization in any one organization. The result is very considerable reduction in stock items and stock investment, cost of handling, and cost of construction, as well as lower prices for material, due to concentration of quantities on few items.

### OBJECTIVES

1. To eliminate duplication; several different items may be used for the same purpose by different crews, whereas one may be agreed upon as most satisfactory. For example, we found some men using small bolts, some lag screws and some wood screws, all for the same kind of job.

While satisfactory results could be had with any of them, all but one could just as well be eliminated from stock.

2. To eliminate unnecessary sizes or designs; make one item serve several purposes if possible. Lag screws were being carried in 3/8 in. and 1/2 in. diameters with several different lengths of each. This was reduced to one length in each diameter, i.e., 3/8 in. × 4 in. and 1/2 in. × 5 in., with most of the use in the latter size.

3. To eliminate obsolete and out of date materials and methods. Originally we were using a great many items of hardware made up according to our own special designs. It was possible in many cases to substitute accepted standards set up by the manufacturer or by other organizations such as the N.E.L.A., with the advantage of obtaining lower cost, quicker deliveries and sometimes a better product.

4. To reduce the size (and hence the cost) of items which are unnecessarily strong and also to increase those which are too weak. On any structure an ideal condition to be sought is to have strength of all parts correspond, rather than to have one part several times as strong as another which is subjected to the same stress.

5. To eliminate unnecessary material in construction by simplified designs. To accomplish this effectively, construction methods and structures, as well as materials, should be definitely standardized by setting up construction specifications and enforcing them.

### Advantages Gained

The reduction in the number of items carried in stock reduces the investment with its accompanying charges for interest and taxes. There is also a reduction in the warehouse space and facilities required, in the cost of handling, of requisitioning, of purchasing and of bookkeeping and records. The stock carried on the line wagons is reduced and the line work simplified. Of course, a reduction in number of items does not lead to a proportionate reduction in total stock since, if three or four styles of insulator are eliminated in favour of one standard, the quantity of that single standard will naturally be larger than any one had been before, but it will usually not be as large as the total of the previous varieties.

The simplification and standardization of line construction accomplishes several purposes. The cost of the unnecessary material used is eliminated, including not only its purchase price but the cost of handling and transporting to the job. In addition, the labour cost of erecting it is saved, which is also an appreciable item. Furthermore, by establishing definite standards to be followed in all construction, the best designs can be selected, safety increased by designing in accordance with established codes and good practice in that regard, work speeded up by elimination of time wasted in "figuring out a job", and maintenance and trouble work simplified due to greater uniformity in the construction.

### Method of Attack

Successful standardization, like any

other kind of engineering, can be worked out only by a proper combination of theoretical and practical knowledge and study. A certain amount can be done at the desk and by laboratory tests on materials. The engineer is likely, unless he has had considerable actual line construction experience, to lean somewhat to the theoretical point of view. It must not be forgotten, however, that the man who climbs the poles and strings the wires may have a lot of ideas that are worth considering, even though he lacks the technical knowledge of stresses, material strengths, Safety Code provisions, etc. Many of them are based on wrong interpretation of his observations but many also on hard won experience. Theoretical calculations of strengths of such structures as are used in lines, where wood and metal parts are used together, are likely to lead far astray from the actual facts. The typical beam and column formulas give results which, in many cases, cannot be checked by actual tests. Field tests under conditions as near actual service as possible, observation of damage done by storms, and discussion with the line foremen are all extremely valuable and necessary in addition to the theoretical calculation. A field trial on a small scale of any new design or material is advisable before it is adopted for general use.

It has been found convenient in this work to follow some such course as this for any one class of items:

1. Assemble all sizes and designs in use and all possible data on each as to its use, advantages, disadvantages, etc.

2. On the basis of these data select one or more items as standards.

3. If necessary, change construction standards somewhat to accommodate the standard material. Care must be taken not to make such changes as will involve important changes in other classes of materials and perhaps add more to the cost in that way than is saved.

4. If desirable, make tests to determine the strength of units, etc. It is sometimes possible to determine the weak points in any design and possible improvements.

5. Determine if the standards proposed conform with safety standards (the National Electrical Safety Code is a good guide) and with manufacturers' standards.

6. Obtain as far as possible the approval of the construction men on the proposed standards. Although it is hard to get unanimous agreements on any change of this kind it is easier to introduce it with the co-operation of the man on the job than against his opposition.

7. After determining the one or more sizes and designs which seem best to fill all these requirements, establish these definitely as standards not to be departed from unless it is decided to change the standard, and do not change the standard without giving the proposed change as careful consideration as the original decision.

8. Get rid of all non-standard materials as soon as possible either by using up on the lines (in case they are not radically different from the standard adopted, as odd lengths of bolts, etc.), by selling where they have a market, or by scrapping.

### PRECAUTIONS

There are a few precautions which must be kept in mind in making such a study. The reduction in number of items may be carried too far. It is always a temptation to cut down to as few items as possible, but economy should be the criterion. The adoption of a single standard which will take the place of two or more items formerly used may sometimes cost more than the retention of the variety. For example, a light cross-arm may be used for a large part of the construction, but a heavier arm is necessary for some cases. The heavier arm might be adopted as a standard and thus one item (the light arm) could be eliminated. The additional cost of the heavier arms, however, might be much more than the savings accomplished by the elimination of a stock item.

Care must be taken to determine all the purposes for which any item is used, especially if it is to be eliminated. It is sometimes easy to overlook the occasional uses for some particular size of material and discover, after it has been disposed of, that a satisfactory substitute is difficult or impossible to find.

Consideration must be given to the maintenance of old lines. Some new material might be more satisfactory than the old, but if it requires radical changes in construction standards, involving perhaps the re-design of other materials as well, and the keeping of duplicate stocks for maintaining old construction, the change should be carefully studied to determine whether or not the ultimate result will be worth while.

The economy of any proposed change should be studied from the basis of annual cost. First cost is usually not a safe determining factor, as an article costing twice as much may give three times as long service. On the other hand, the length of service desired must be considered. This is important where metal parts are used with wood, such as metal cross-arms with wood poles. The metal may outlast the wood several times but the cost of salvaging it, together with its additional first cost, may point to the use of a cheaper wood article with shorter life. Also the fact that line construction is subject to many changes, due to changes in load, voltage, improved design of materials, interference with new buildings, streets, etc., makes an extra cost for long life often inadvisable.

The more simple the materials and the structures can be kept, the better. It is a great temptation sometimes to introduce some new "gadget" which is just the thing for some specific use. Careful consideration may show, however, that it is not half so necessary as it seems and may have only a very occasional use. An accumulation of such "gadgets" loads up the warehouses and is a distinct expense.

It is important that the maintenance of safety be kept always in mind. That does not mean that excessive strength should be used to make construction extra safe. The desire to cheapen construction and reduce the number of standard materials should not lead to the introduction of unsafe construction. The maintenance of proper clearances, climbing spaces, working space and

of minimum safety factors in strengths should be always of primary importance.

A standardization of quality of materials as well as design is essential. This should be accompanied by a system of inspection of materials purchased to determine if they fulfill specifications.

### Maintaining Standards

In order that standardization work be really worth while it must be more than a job done once and for all. It must be maintained by continued attention by an experienced staff. Otherwise, the tendency is to drop back to the old condition. New ideas are continually coming up and they should be adopted if they make for better construction or lower costs. It is surprising how often further improvements and simplification can be made in materials or designs which have been previously given very careful study.

Another important factor is the enforcement of construction specifications. There is no entirely satisfactory middle course between letting the line crews do about as they please, with perhaps a few drawings and rules to guide them, and the other extreme of having complete specifications covering practically all details of construction. The latter method requires time spent by a layout man in planning each job in contrast to time spent by a crew in figuring out what they are going to do.

### Results

The practical results of systematic standardization has been found to be well worth the effort expended. In The Detroit Edison Company the conditions were not at all bad when this work was started and probably no worse than exists in some companies today. It was possible, however, to reduce the number of items of Overhead Lines material stock somewhat more than 50 per cent. on the first study and further reductions have been made from time to time since.

It is evident that such reductions as these cannot help but produce real economy in lower investment, lower handling costs and cheaper line construction.

NOTE:—The Distribution Section of the Commission's Electrical Engineering Department has gained considerable experience in the construction of some 10,000 miles of rural lines, and has standardized to a large extent in materials and design.

Specifications and drawings have been revised from time to time where laboratory tests and field experience indicated the necessity therefor.

A recent revision of a handbook which is entitled "Standard Specifications and Drawings for use on Rural Lines" is available for those who are interested, and while compiled primarily for the construction of rural lines, should be of value to those concerned with urban construction.

The handbook contains 139 drawings and some 100 pages of text. The book is in loose-leaf form and is supplied with a substantial cover.

Copies may be obtained at $2.00 each.—Editor

*The concession area of nearly 7 acres in which exhibitors*

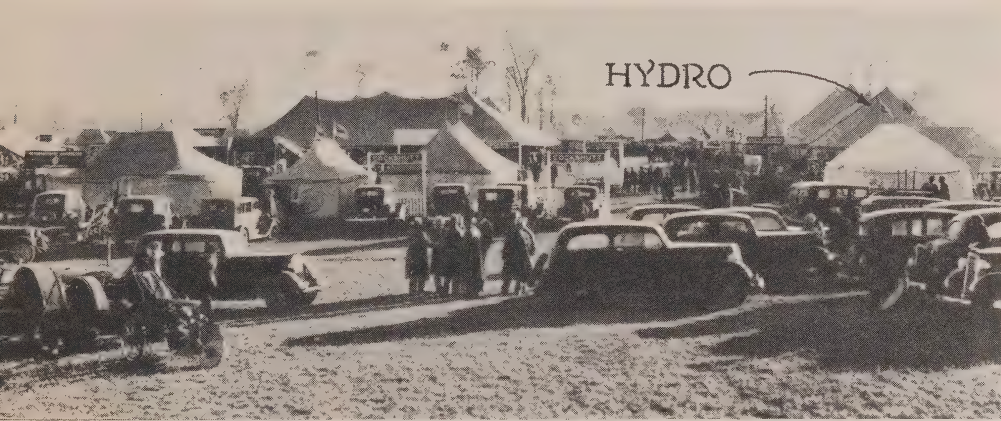
# Hydro Demonstration at the International Plowing Match

THE International Plowing Match of the Ontario Plowmen's Association and a farm machinery demonstration, was held this year on October 15th to 18th, in Haldimand County near Caledonia, on the farms of Mr. L. H. McKibbon and his neighbours. It passes into history as the most successful match of the Association, and is said to be the biggest ever held in the world. The attendance, number of entries of contestants, rental of concessions and other features exceeded all former years. The promise of fine weather and the fulfilment of that promise undoubtedly had much to do with its success as far as attendance and entries were concerned. County matches have developed a great interest in this young farmer's Olympia. The attendance was estimated as being in excess of 100,000 people, and 60 per cent. of these were there on one day, Thursday the 17th.

The concession area was laid out in a rectangle, all lots fronting on 60-foot streets around a central area, which had a 14-foot lane. This arrangement permitted all exhibitors and cafeteria operators to have back yards for their cars, trucks and paraphernalia. The total frontage of concession lots was about 2,400 feet.

The water system for the grounds required 1,200 feet of pipe with three pressure tanks to supply six taps and hot water service, the automatic electric-driven pumps and tanks being loaned for this purpose by Beatty Brothers. Unfortunately, the well capacity was only sufficient for partial service.

The Commission's electric system required 400 feet of 4,000 volt and 1,300 feet of 110-220 volt line, the erection of a 25 kv-a. transformer




*lisplayed their machinery and cafeterias served the public*

and seven street lights. Thirty-five services were connected to concessionaires' tents or areas, as well as the Hydro and Headquarters tents.

The demonstration of the Commission was housed in a tent 40 by 60 ft., which was erected in alignment with the headquarters and Eaton's rest tents in an impressive arrangement across the end of the rectangle. The illuminated tents and the street lights viewed from the Hamilton-Port Dover highway at night surprised some night travellers to the extent that they thought a small municipality had sprung into existence over night, and others some distance away were surprised by the illumination,


*View along the 60-ft. street from the entrance to the Hydro tent; the crowds at times filled this street. This is only a portion of the 60-ft. street which extended all around the center concession areas.*

*General arrangement of the displayed machinery and equipment in the Hydro tent. The smaller farm and dairy machinery and many household appliances were featured.*

as it was in quite plain view for miles by reason of the elevation.

The equipment on display in the Commission's demonstration was loaned by manufacturers, who had representatives in attendance to supply full information to visitors. The assembly was divided by a partition part way across the tent, one half being devoted to household appliances and equipment, while the other was used for barn and dairy machinery and electric soil heating for hotbeds and greenhouses.

In the household section, full lines of electric ranges, washing machines, ironers and appliances were shown. There was also a complete three-piece bathroom and kitchen sink, all of moderate cost and good quality. The Commission's free water heater in operation, attracted a great deal of attention.

On the farm machinery side, there were three types of milk coolers, three individual grain grinders, three milking machines, an assortment of motors and parts, a full line of pumps for all sorts of water supply conditions to meet all pocket books, as well as a sump pump which might profitably be used on many farms to meet drainage requirements. Comparative growth in an 18-day period with and without under-earth electric heat were shown in two hotbed sections.

The farm machinery side of the exhibit attracted the greater attention. Many of those interested are

not at present taking Hydro service, but expressed themselves as anxious for it as soon as they could undertake new obligations.

The Commission's prize for tractor Class 16—first prize—was a half-horsepower Wagner motor won by Mr. Fred Timbers of Ringwood. He is not at present a Hydro user, but when it was suggested the prize be arranged in cash, without hesitation, he said: "No, we will have Hydro soon."

The match was concluded by a banquet provided by the counties of Haldimand and Brant and the town of Caledonia, at which about 1,000 participated—another record being broken by the number in attendance.

The success of this match and demonstration was apparently much appreciated by all who participated in any way, especially the many local and county committees who had worked for months to make preparations.

The Plowmen's Association is to be congratulated on the intense interest that has developed in this annual affair.

# The Installation of a 45,000 kv-a. Frequency Changer Set at Chats Falls

By G. H. Bradshaw, Assistant Engineer, Electrical Engineering Dept., H.E.P.C. of Ont.

THE Hydro-Electric Power Commission of Ontario recently placed in service a Frequency Changer Station at Chats Falls to supply power to she 60 cycle system of the Commission. This paper covers a general description of that installation.

*Diagram and L.V. Switching.*

Fig. 1 shows the single line diagram of the Chats Falls Frequency Changer Station, including No. 2 and No. 3 generators of the Chats Falls Generating Station with their transformer bank which were placed in service during 1931. These two generators were connected to the 220 kv. transformer bank through a metal-clad structure containing two oil circuit breakers, one for each generator. To connect the frequency changer set to the same two generators, it became necessary to break into the existing metal-clad structure and install a motor-operated, oil-insulated disconnecting switch directly behind the original structure. From the bus side terminals of this disconnecting switch, a metal-clad bus, 54 feet long, connects to a similar motor-operated disconnecting switch to supply the 25 cycle motor of the frequency changer. These two disconnecting switches are electrically interlocked so that neither can be closed unless the other is open. With the above installation No. 2 and No. 3 generators could be used to supply either the frequency changer set or the 220 kv. transformer bank, but not both simultaneously. For flexible operation, a new metal-clad, oil circuit breaker was added connected as shown between No. 3 generator and

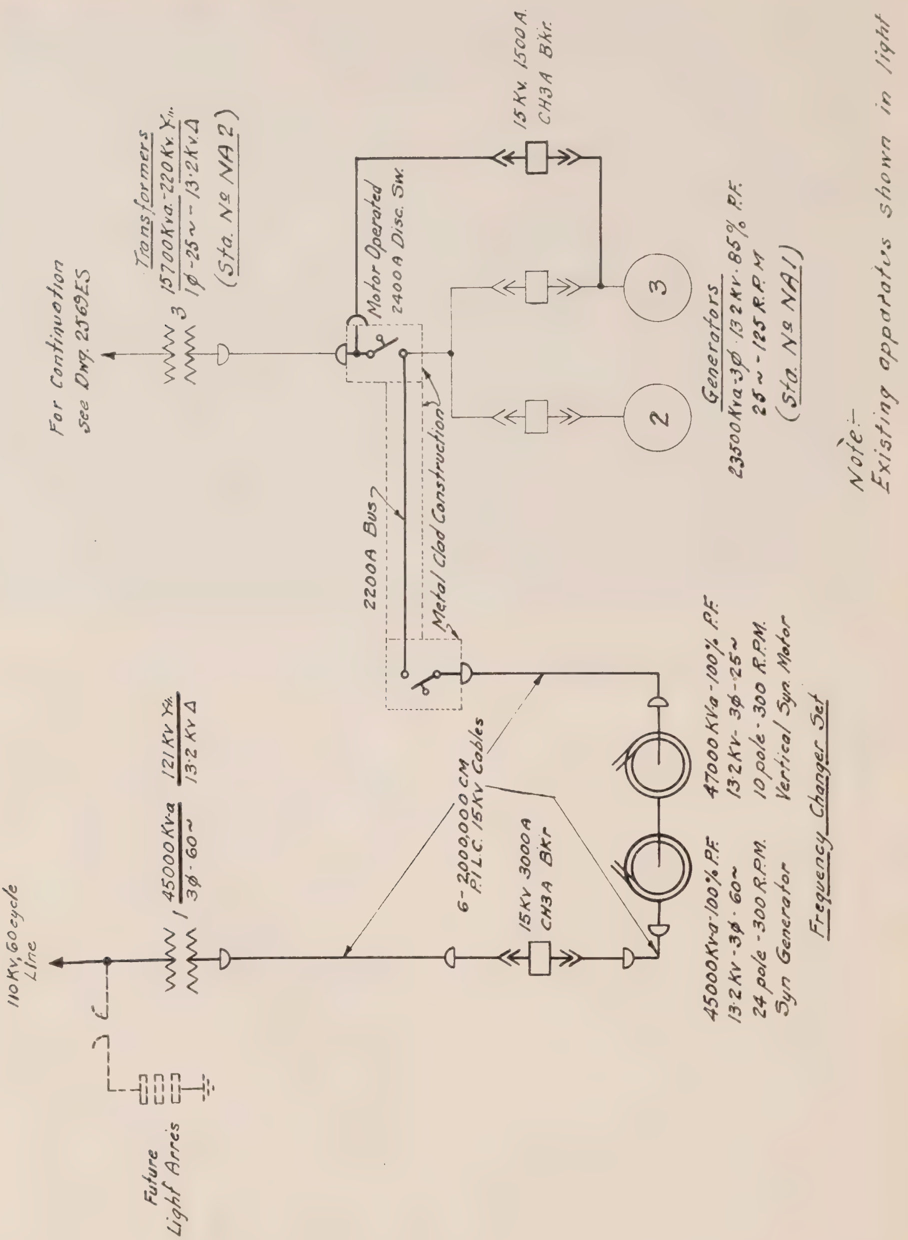



*Fig. 1—Single line wiring diagram of the Chats Falls Frequency Changer Station, including No. 2 and No. 3 generators of the Chats Falls Generating Station with their transformer bank.*

the 220 kv. bank, making it possible to connect No. 2 generator to the frequency changer while No. 3 generator supplies the 220 kv., 25 cycle bank.

The 60 cycle generator of the frequency changer supplies a 3 phase, 45,000 kv-a. transformer through a 13.2 kv. oil circuit breaker of metal-clad construction.

*Superstructure.*

The frequency changer set is installed in a 62 foot extension on the Ontario side of the Chats Falls Generating Station. The building is of structural steel and plastered tile and detailed in general to conform with the original structure. The building interior and the various equipments have been painted, using the same colour scheme adopted for the generating station, based on dark and light shades of grey-green contrasted with cream. The foundation of the changer set is of concrete dowelled to the solid rock and very heavily reinforced.

The transformer bank is located outdoors on an extension to the original transformer station and extensions to the existing water and oil headers connect to the new bank from the tunnel beneath the transformers.

*The Frequency Changer Set.*

The frequency changer is a three-guide bearing, vertical synchronous-set with a common shaft 32 feet in length, with the rotors supported from a Kingsbury thrust bearing located at the top. The complete set is over 40 feet high with the 25 cycle unit below, supporting the 60 cycle unit with a 45-inch high spreader frame between. The stators are 19 feet 3 inches in diameter. The $WR^2$ value for the changer set is 10,960,000 lbs. ft.$^2$

The frequency changer set consists of a 47,000 kv-a., 100 per cent. power factor, 13,200 volt, 3 phase, 25 cycle, 300 rev. per min. vertical synchronous motor, directly connected to a 45,000 kv-a., 100 per cent. power factor, 13,200 volt, 3 phase, 60 cycle generator. The set is the rigid type with a total weight of 1,040,000 lbs. and is capable of operating either way with an output of 45,000 kv-a.

The set requires 153,000 cubic feet of cooling air per minute which is divided 75,000 and 78,000 for the 25 cycle and 60 cycle units, respectively. This air may be drawn from outside or may be re-circulated from the generator room. A steel casing around the 25 cycle stator forces the outgoing air into one of the water passageways in the headworks, originally installed for the future No. 1 turbine, and is vented to the outside air through a penthouse constructed on top of the headworks. The outgoing air from the 60 cycle generator is discharged into the generator room. Provision is made in the roof of the plant to discharge this warm air in the summer. In case of trouble in the machine the air is automatically cut off both by intake and outlet dampers.

A complete automatic self-contained lubricating oil system is provided for the changer set. Two duplicate motor-driven oil pumps, one a standby to the other, supply the thrust and three guide bearings. When the set is to be started, the normal operating pump is placed in

service. If for any reason, the pressure in the oil feed pipe decreases below the predetermined amount, the standby pump is automatically-started by the contacts of a pressuretrol, and a visible and audible alarm is given, notifying the operator that the normal oil pump is in difficulty.

An interesting device is provided to facilitate the starting of the frequency changer set from rest, consisting of a 400-ton hydraulic jack equipped with a large roller bearing. The jack is installed directly below the shaft and the first operation in starting is to raise the rotating part of the set, weighing 460,000 lbs., to ensure a good film of oil between the thrust bearing plates, located above the upper bracket. As soon as the shaft begins to revolve, the jack is lowered by a quick release valve.

The frequency changer set has a separate excitation system, motor-driven, comprising a 600 h.p., 25 cycle, 550 volt, 750 rev. per min. squirrel cage motor driving two 200 kw., 250 volt shunt would generators, one on each side of the motor, for the 25 and 60 cycle units. A 10 kw. pilot exciter is directly connected to one end of the common shaft. The 600 h.p., 550 volt driving motor would require approximately 2,750 kv-a. with across-the-line starting. As this load was too great for the capacity of one station service transformer bank, starting equipment consisting of an auto-transformer, magnetizing, starting and running oil-circuit breakers, all of metal-clad construction, was installed on Elev. 223 adjacent to the exciter set. A minatrol switch on the exciter switchboard initiates the starting sequence for the exciter set motor, closing the magnetizing and starting breakers. A type CV timing relay automatically opens these two breakers and closes the running breaker at the proper time.

A voltage regulator is supplied for the 60 cycle generator only, but provision has been made for the future addition of a regulator for the 25 cycle end.

An interesting and very fortunate incident occurred during the installation of the changer set. As described above, there is a common shaft for both the 25 and 60 cycle units. The 25 cycle rotor spider was shrunk on the shaft in the factory and shipped to the site where the pole pieces and coils, fans, etc., were assembled. The 60 cycle rotor is bolted to two flanges integral with the shaft. The installation schedule allowed for two balancing operations of 4 days each, first for the 25 cycle rotor and shaft, and second with the 60 cycle rotor bolted in position. The changer was completely assembled except for the 60 cycle rotor and by using temporary cable connections between No. 2 generator and the 25 cycle motor main leads, was spun to check balance. It was found to be perfectly balanced as installed. The upper bracket with the thrust bearing was then removed and the 60 cycle rotor placed on the shaft and bolted and the machine re-assembled, requiring about 36 hours working time for 6 men. Again the rotors were spun and again found to be in perfect balance. Readings were then taken of the total sideways movement of the shaft and this was found to be 2½ mils or 1¼ mils each way.

Considering that the three guide bearings have a clearance of 7 mils over the shaft, the complete rotating part weighing 460,000 lbs. revolves at 300 rev. per min. floating in the guide bearings. Such a result is extraordinary and is probably due to the extreme care taken in designing the foundations and during machining and fabricating operations in the factory and during the assembly in the field. Credit is due also to the careful inspection and co-operation both in the factory and in the field of the Commission's laboratory engineers.

*Transformer.*

The power transformer is a 45,000 kv-a., 3 phase, 60 cycle, 121,000/13,200 volt, oil-insulated, water-cooled bank, 50 deg. cent. rise, with graded insulation in the high voltage winding and of surge-proof design. The neutral is solidly grounded. A hand-operated, no-load tap changer is included with a 5 per cent. tap above, and below normal on the high voltage windings. Thirty per cent., 35 per cent. and 40 per cent. tap stubs were brought out of the low voltage winding for future starting of the frequency changer set from the 60 cycle system.

*Power Cables.*

All connections between metal-clad switchgear, frequency changer and transformer are made with paper-insulated, lead-covered cables of 2,000,000 cir. mils stranded copper using two cables per phase. The 25 cycle cables are standard stranding while the 60 cycle cables have a one-inch diameter rope core. All power cables end in pot-heads attached to the framework of the various equipments.

*Control, Relay and Metering.*

The several switchboards for the control of the frequency changer set and its auxiliary equipment were made up and installed as far as possible to conform with the original installation of the Chats Falls Generating Station.

A small bench and meter board, 30 inches wide, but of the same design as the main bench board, is installed in line with it in the control room. The new bench board contains the control switches for the low and high voltage switching equipment incorporated in a simple dummy bus layout. On the upright portion are the indicating meters, being the illuminated dial, flush-mounting type. Separate small annunciator plates with individual lights for each relay protection feature are installed on the top of the bench, one for the 25 cycle unit and one for the 60 cycle unit. A common engraved key plate between the two annunciator plates explains the various symbols as used on the small white lenses of the lights.

The regulator panel for the 60 cycle generator and the ground detector panel for the complete frequency changer set adjoin similar panels for the generators.

Two switchboards are installed adjacent to the changer set, the exciter switchboard on the main generator room floor Elev. 221 between the motor-driven exciter set and the changer. This board, besides having the usual main and exciter field

breakers for the changer has on each end the motor-operated rheostats and the contactors for the 60 cycle regulator. The centre panel of this board contains the starting control for the 600 h.p. motor of the exciter set and the automatic throw-over control equipment for the lubricating oil pumps on the changer.

The relay switchboard, installed on Elev. 223, also has recording meters for the 60 cycle generator and 600 h.p. exciter set motor, and the two starting panels, one for No. 2 and No. 3 generators and one for the 25 cycle motor.

The frequency changer set is started from rest from either No. 2 or No. 3 generator and all breaker and rheostat controls of both generators and the 25 cycle motor are transferred from the control room to the starting panels which overlook the changer set by two "Start and Run" transfer switches.

Each operation in the starting sequence is by hand control, but each operation is supervised electrically by suitable relays or interlocking connections which insure complete operation of each step in the sequence before the next step may be made. If an error in sequence is made, the equipment is automatically cleared and a new start must be initiated.

The first operation necessary when starting the changer set must be to take the weight of the two rotors and shaft on the 400 ton hydraulic jack below the bottom of the shaft. When this operation is complete, the jack operator (El. 190) signals the starting operator (El. 223) by means of a light on the starting panel. When the machine starts to revolve the jack is lowered by a quick release valve.

With the starting generator running at normal speed, the voltage is raised gradually to start the frequency changer. A normal start requires about 1,800 amperes and the changer reaches normal speed in about 8 minutes. The field of the 25 cycle motor is not applied until the changer set is up to speed, and the voltage of the generator nearly up to no-load value. Then the field circuit breaker of the motor may be closed and voltages adjusted to normal.

The set is now ready for synchronizing to the 60 cycle system and all controls are transferred to the control room from where actual synchronizing is done and load picked up.

A complete relay protective system for both units of the frequency changer and for the transformer bank has been provided. The relay system is divided into the following features:

No. 1A—Split phase protection 25 cycle motor.

No. 11A—Split phase protection 60 cycle generator.

No. 1B—Zone differential protection 25 cycle motor.

No. 11B—Zone differential protection 60 cycle generator.

No. 1C—Armature ground detector 25 cycle motor.

No. 11C—Armature ground detector 60 cycle generator.

No. 1D—Field ground detector 25 cycle motor.

No. 11D—Field ground detector 60 cycle generator.

No. 1E—Overvoltage protection 25 cycle motor.

No. 11E—Overvoltage protection 60 cycle generator.

No. 1F—Standby protection 25 cycle motor.

No. 11F—Standby protection 60 cycle generator.

No. 1G—Overspeed 25 cycle motor.

No. 11G—Overspeed 60 cycle generator.

No. 12A—60 cycle transformer bank protection.

No. 13—Exciter set motor protection.

No. 14—13.2 kv., 25 cycle bus differential.

No. 15—Line protection.

Besides the above features, it was necessary to revise the generator and transformer relay protections of the original installation on No. 2 and No. 3 generators and their 220 kv. transformer bank to co-ordinate them with the additional protective features of the frequency changer.

It might be mentioned that although there are two over-speed devices for the changer set, they are both mounted, one above the other on the top of the extension to the main shaft, and one device acts as a standby to the other. These devices are of the mechanical centrifugal type. The frequency changer is guaranteed to withstand a 25 per cent. overspeed, but it is connected to two waterwheel-driven generators designed to safely withstand 100 per cent. overspeed. To give maximum security and certainty in tripping off the input to the frequency changer, these devices are connected to duplicate tripping circuits and relays to clear both generators. The devices are both set to trip off at 15 per cent. overspeed.

Directly below the overspeed devices and on the same shaft extension is mounted a small commutator which automatically prohibits synchronizing between the 25 cycle motor and starting generator unless conditions are correct for so doing.

GENERAL

The Construction Department of the Hydro-Electric Power Commission started work on the building and structures on May 15th, and the Canadian Westinghouse Co. started field assembly of the set on July 20th. The Chats Falls Frequency Changer Station was placed in service and carried load on October 13th, 1935.

An interesting fact regarding this installation is that notwithstanding the arduous schedule of construction, not one serious accident occurred.

Description photographs of interest pertaining to the Frequency Changer Station will be printed in an early edition of this same publication.

# Discussion on Kw., Kx. and Kv-a. Flow

By H. S. Baker, Meter Supervisor, H.E.P.C. of Ont.

SINCE there appears to be a little uncertainty in the minds of some operators, and others, in regard to some aspects of r.kv-a. flow, I wish to submit the following which, it is hoped, will be instructive in regard to this matter.

The abbreviation "kx" will be used instead of "r.kv-a".

The older conception of reactive kv-a. flow, visualized it as always flowing in a plus direction along a line section (plus direction being generally taken as, from the generator towards a motor) and that its algebraic sign was indicated by calling it "lagging" or "leading" r.kv-a.

A later and more useful method of visualizing the same physical conditions is the result of the fact that lagging reactive kv-a. flowing in one direction along a line is exactly the same physical condition as leading reactive kv-a. flowing in the opposite direction.

The later method visualizes *only lagging* r.kv-a. flowing (in a plus, or in a minus, direction), and calls it plus kx. or minus kx.

Kirchoff's law regarding the algebraic sum of d.c. amperes arriving at a junction point in a hook-up, being zero, (if all plus directions are taken as towards the point), applies also to kw. arriving at a junction in an a.c. hook-up, and also applies to kx., provided the latter method of viewing it is used.

A whole hook-up may be checked up in regard to the consistency of kw. flow in all its links by applying the above algebraic law at all junction points, regardless of the values of kx. in the various links.

Similarly a kx. check up can be made regardless of kw. values. The kx. may be flowing with or against the kw., in any link of the hook-up, as will be shown later.

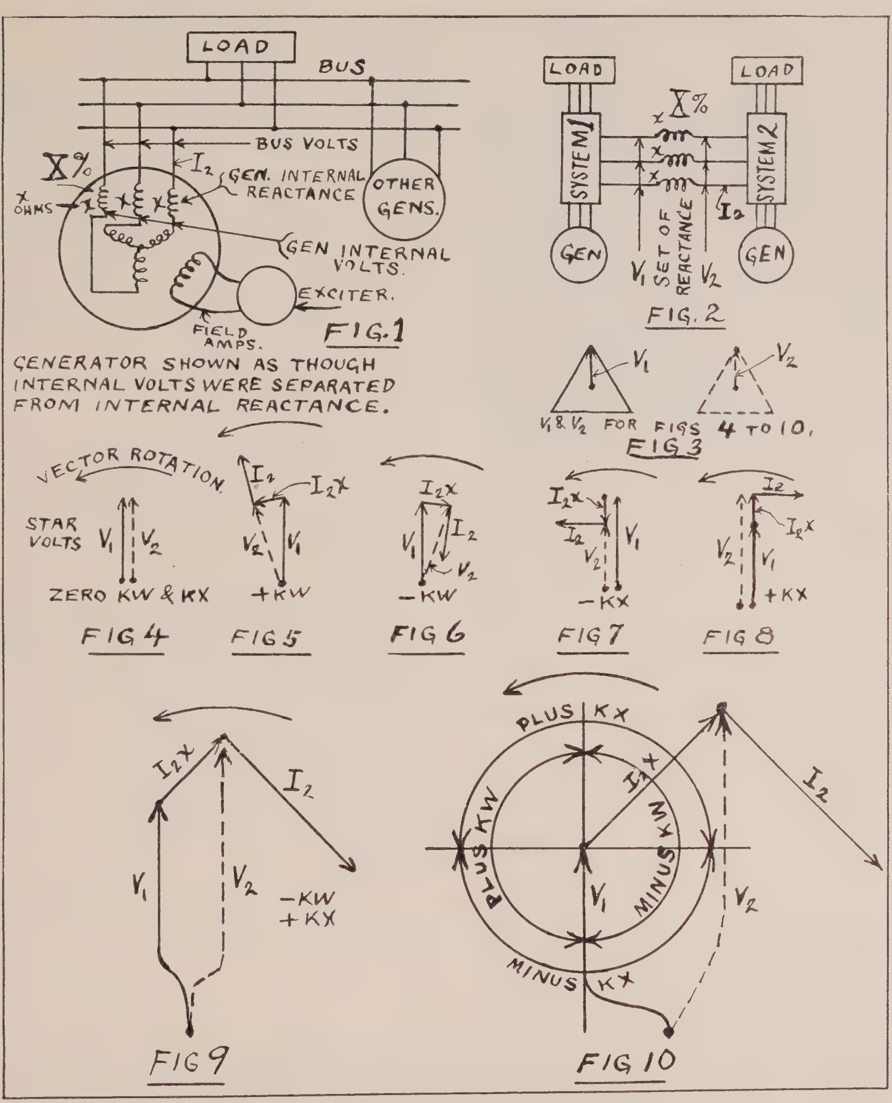
Thus, power service to customers can be divided into two distinct services fed over the same transmission hook-up. They are, "Power" or energy component service, or kw., and "Excitation" or reactive component service, or kx.

Since kv-a. is the square root of the sum of the squares of kw. and kx., and since a square root has no single algebraical sign, then kv-a. has no direction of flow and it does not obey Kirchoff's law in a hook-up, except in special cases.

The same law of losses being the difference between input and output, applies to kx. (or $i^2x$ losses) as to kw. (or $i^2r$ losses).

A generator connected to a bus, as in Fig. 1, with no torque applied to its rotor, (and with the same value of field current that would sustain bus voltage with the generator disconnected from the bus), is delivering neither kw. nor kx. to the bus. (See also Fig. 4).

If a torque is applied to the rotor of the generator in the direction of rotation (with the generator on the bus) then it begins to generate power and force it into the bus. Its internal




voltage rector, $V_2$, assumes a lead ahead of $V_1$ as in Fig. 5. The $I_2x$ drop in the reactance will be the vector difference $V_2$ minus $V_1$ as shown, and $I_2$ will lag this drop by 90 degrees, causing a flow of positive kw.

If the torque on the generator shaft is against the rotation, it becomes a motor. The vector $V_2$ falls back behind $V_1$ and we have negative kw., as shown in Fig. 6.

In Fig. 7, we have the case of zero torque, and zero phase difference between $V_2$ and $V_1$, but we have weakened the generator field, thus causing $V_2$ to become shorter. The $I_2x$ drop on the reactor, being the

vector difference $V_2$ minus $V_1$ is as shown and $I_2$ takes a position of leading amperes, or minus kx.

The reverse of Fig. 7 is shown in Fig. 8, for zero torque, but for strong generator field, and the result is plus kx.

In Fig. 9 we have the combination of negative torque (or lagging $V_2$) and strong field (or long $V_2$). The result is that $I_2x$, and $I_2$ take up the positions shown and we have both negative kw. and positive kx. at the same time.

Fig. 10 shows the four quadrants in which $I_2x$, or the vector difference $(V_2-V_1)$ may lie. The upper two quadrants imply long $V_2$, or strong field, or plus kx. The lower two quadrants imply the opposite. The right hand two quadrants imply negative torque, or lagging $V_2$, or minus kw. as in a motor. The left hand two quadrants imply the opposite, or plus torque, leading $V_2$, positive kw.

The time-vectors diagrams (Figs. 3 to 10) apply equally well to a tie between two systems (shown in Fig. 2), as to the case shown in Fig. 1.

In Fig. 2, the application of Fig. 10, shows that with arithmetically equal voltages on the ends of a reactive tie, the transfer of power is at unit power factor.

The kx. transfer across the tie reactor group in Fig. 2 may be calculated in terms of $V_1$, $V_2$, V and x, where x is the per cent. reactance of the tie based on 10,000 kv-a., at voltage V, and where D is the arithmetic difference of $V_1$ and $V_2$. Then

Kx. flowing from $V_1$ into the reactor is,

$$\text{kx.} = \frac{D\ V_1\ 1000\ 000}{V^2\ x}$$

The kx. loss in the tie is given by

$$\text{kx. loss} = \frac{D^2\ 1{,}000{,}000}{V^2\ x}$$

The kw. transfer through the tie is dependent on the phase angle between $V_1$ and $V_2$, and is dependent on x.

If the maximum safe kw. transfer is desired, and if 30 degrees be considered as the maximum safe angular difference between $V_1$ and $V_2$ to avoid pulling the two systems out of step, then

$$\text{Max kw. transfer} = \frac{500{,}000}{x}$$

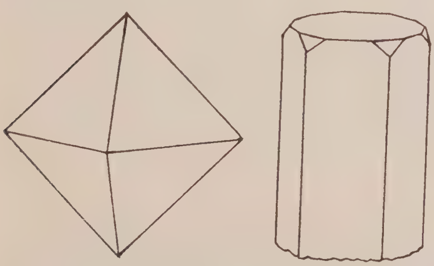
# Patterns on Natural Crystals

NATURAL mineral crystals usually are quite conventional in form, appearing as cubes, hexagonal prisms, or other four, six, eight, twelve, or even twenty-four-faced solids. Some are clearly transparent while others are only translucent, or actually opaque.

Most crystals have flat faces, some diamonds being the exception, and the angles between adjacent faces are so definitely fixed, according to the composition of the materials, that a measurement of these angles is used as a means of identifying the crystal.

On the flat faces of some crystals there appear distinctive conventional markings, or growth figures. These are simple geometrical shapes, associated with the system of crystallization, and, on any given face of the crystal, they have the same orientation. Crystal formation and the uniformity of these minute patterns show one aspect of the manner in which Nature perfects her work.

Two of the precious stones, namely, the diamond and emerald, show these growth figures on many specimens of the natural crystals.



*a—Diamond (Octahedron)* *b—Emerald (Hexagon Prism)*

*Fig. 1—Natural crystal forms*

*Fig. 2—Growth figures on one face of a diamond crystal. Magnification = 60×.*

*Diamonds.*

While most diamond crystals have rounded faces and curved edges, some are found with flat faces and of geometrical form, the most common being the octahedron, or eight-faced solid, shown in Fig. 1-a. Crystals of gem quality are clearly transparent and growth figures may be seen on all faces. These are not usually

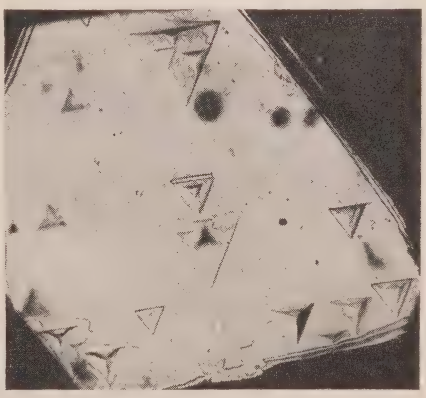


*Fig. 3—Growth figures on another face of the same diamond crystal, as shown in Fig. 2. Magnification = 45×.*

*Fig. 4—Growth figures on the face of an emerald crystal. Magnification = 60×.*

visible to the unaided eye and require a magnifier, or microscope, having a power of eight, or higher.

Photomicrographs of the growth figures on two faces of a small diamond crystal are shown in Figures 2 and 3. It will be seen that these are practically perfect equilateral triangles, and that all are turned in the same direction.

A few of these triangles appear out of focus and reversed. These, however, are on the opposite face of the transparent crystal.

*Emeralds.*

Natural crystals of the emerald are hexagonal in form as shown in Fig. 1-b. The growth figures are also hexagonal, or an elongated diamond shape having angles of a hexagon, 120 degrees, and all of these figures have sides parallel to those of other figures on the same face of the crystal, as shown in Fig. 4. As with the diamond, these figures usually cannot be seen without the aid of a magnifier.

The accompanying photomicrographs of natural mineral specimens were taken in the Laboratories of the Hydro-Electric Power Commission. The diamond came from Kimberley and the emerald from Brazil.

*F.K.D.*

# The Use and Care of Flexible Cords for Electrical Appliances and Devices

THROUGHOUT the United States generally, there is no State Authority with legal power to set standards for the quality of material and workmanship that go into the making of electrical materials and equipment; as a consequence the grade of many electrical products is very inferior and this results in an unnecessarily large number of cases of electrical fire and shock.

Some time ago a concerted effort was started to remedy this condition, and the electrical utility companies, the electrical manufacturers and jobbers, electrical inspectors and other authorities have been and are acting together to try to educate the public to purchase only appliances and other equipment that have been approved by the Underwriters' Laboratories which, for years has performed a most useful function in setting standards of construction. The efforts thus put forward in the United States in showing the people the value of good equipment properly installed have already borne fruit and are said to have reduced a fire loss of $15,000,000 in 1930 to one of $11,800,000 in 1932; in achieving this reduction it is claimed that extra care and attention given to the selection and use of flexible cord has played a considerable part.

In Ontario, the Hydro-Electric Power Commission safeguards the consumers of electricity by requiring that all electrical materials in general use by the public be inspected and tested at its Laboratory and given its official approval before they may be sold, or otherwise disposed of, or used, in the Province. The Commission is legally empowered to do this work and penalties are prescribed for infractions of the law. So far as *new* equipment is concerned, therefore, the people of this Province are well protected (although occasionally some unscrupulous individual manages to sell unapproved material or devices to unsuspecting persons), but neither the Commission nor any other body could check and inspect all electrical equipment after it has been put into service.

Electricity is undoubtedly the safest active source of energy at man's disposal and, with modern materials and equipment, is the most easily kept under control, but, like all other forms of energy it can become unsafe to handle if reasonable precautions are not taken to keep it within bounds.

While all electrical appliances and devices need attention at times, the flexible cords used in connection therewith are generally more liable to suffer from wear and tear than the equipment to which they are connected. Such cords should therefore be examined at fairly frequent intervals to see whether the covering is wearing out, whether the ends are becoming frayed and whether any of the wires have become detached from the terminals. If the ends are

frayed and the cord is sufficiently long the ends can be cut away and the cord re-connected; but if the covering be worn farther along the cord, or if a strand of bare wire has worked its way through the covering, the whole length should be discarded and replaced by a new one.

Flexible cord is made in a number of different grades; some are suitable for ordinary conditions, e.g., in a house or office, where they are not likely to be subjected to hard usage, water, or high temperature; others are suitable for hard usage in dry and relatively cool locations; still others are designed to withstand moisture or high temperatures with or without hard usage. Whenever a length of flexible cord on any appliance has to be replaced it is therefore necessary to see that the new cord is of a type suited to the conditions under which it is to be used. In most cases the type that was supplied with the appliance when it was new should be employed, for, in Ontario, the Commission not only approves electrical material and equipment for general use but in certain cases the approval covers specific uses and it is unlawful for anything bearing specific approval to be used for any purpose not covered by such approval. Care should be taken also that the size (Gauge No.) of flexible cord is the correct one for the appliance or device to which it is to be connected. By selection of the most suitable type of cord for any given use and by proper care in handling it, flexible cord can easily be made to last a reasonably long time.

When removing a plug from any appliance or receptacle, the plug, not the cord should be grasped; cords should not be sharply twisted or kinked, neither should they be trodden on; cords should be kept out of contact with metal pipes and fittings, especially any that are either hot or wet, and they should not be allowed to rub against any surface, whether of metal or not, unless they are of a type specially made to withstand hard usage. No appliance should be lifted by means of the cord attached to it. It is illegal in Ontario to employ flexible cord as permanent wiring by fastening it to walls, baseboards, picture-moulding, etc., and it is a dangerous practice to run it through doorways or under rugs. Flexible cords should be as short as is reasonably possible and not run and looped around rooms in long lengths.

Simple precautions such as the foregoing will enable users of electricity to obtain good and safe service out of their flexible cords, and, if like attention be paid to plugs, appliances, etc.—e.g., if loose screws be tightened up, missing ones replaced as soon as possible; if smoothing-irons and other portable sources of heat be disconnected as soon as they are done with; if portable electrical heaters and other portable electrical devices be kept out of bathrooms and other places where there are water pipes and metal fixtures attached thereto—there will be little danger of fire or shock from electrical causes on any person's premises.

All electrical installation work and repairs thereto should be done by an experienced electrician; the local Electrical Inspection Department will gladly supply the names of several such on request.

# THE BULLETIN

Published by

HYDRO-ELECTRIC POWER COMMISSION

of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year


## Agreement and Plan of Employee Representation

### FOREWORD

THE Commission has desired to have a method developed by which matters of mutual concern to the Employees and the Commission could be discussed and appropriate action taken.

Authority was granted to create a committee composed of Representatives of the Commission and elected Representatives of the Employees to develop a Plan of Employee Representation. This Committee was composed as follows:

Representatives of Employees: W. A. Armstrong, H. Duncan, E. B. Dustan, W. B. Ford, A. C. Holcombe, H. C. McElrath, James Poppleton, R. H. Roe, G. E. Whitaker.

Representatives of Comission: H. C. DonCarlos, T. H. Hogg, R. T. Jeffery, Wills Maclachlan, A. Murray McCrimmon, W. G. Pierdon.

The Committee held meetings in April, May, July, September and October of 1935 and drafted the Plan of Employee Representation. This Plan, at the request of the Employee Representatives, has been implemented by an agreement which has been signed by the Commission and the Employee Representatives.

It is the hope of all concerned that the full possibilities of mutual co-operation will be obtained.

* * * *

AGREEMENT made this 23rd day of October, 1935.

BETWEEN

The Hydro-Electric Power Commission of Ontario, hereinafter called the

Party of the First Part,

and

All the Participating Employees of the Hydro-Electric Power Commission of Ontario, hereinafter called the

Party of the Second Part.

WHEREAS it is desirable that The Hydro-Electric Power Commission of Ontario and its employees co-operate

## CONTENTS

**Vol. XXII No. 11**

**NOVEMBER, 1935**



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

---

to the mutual advantage of each, and that to this end means be provided for the exchange of information, the discussion of problems, the statement of grievances, the consideration of proposals for betterment, with a view to prompt, wise and appropriate action, and

WHEREAS, for the purposes above stated, the parties hereto have agreed to a plan of Employee Representation,

THEREFORE, the parties hereto agree to the terms and conditions hereinafter set forth in the Plan of Employee Representation, marked as Schedule A, and forming part hereof, and have pledged themselves respectively, and mutually promise and undertake, to act in accordance with the said plan as so stated, and not otherwise, and to carry out the same in full accordance with its true intent and meaning.

In witness whereof The Hydro-Electric Power Commission of Ontario has hereunto affixed its Corporate Seal under the hands of its Chairman and Secretary, and all the participating employees of the Commission have signified their binding assent thereto under the hands and seals of the signing officers of their elected representatives' Committee, thereunto duly authorized.

The Hydro-Electric Power
Commission of Ontario

T. S. Lyon

(SEAL) *Chairman*

W. W. Pope

*Secretary*

All the Participating Employees of the Hydro-Electric Power Commission of Ontario

J. A. Armstrong
H. Duncan
E. R. Dunstan
W. B. Ford
A. C. Holcombe
H. C. McGrath
James Poppleton
R. H. Roe
A. Williams

SCHEDULE A

to Agreement dated the 23rd day of October, A.D. 1935, between The Hydro-Electric Power Commission of Ontario and all the Participating Employees of the said Commission and forming part thereof.

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

## PLAN OF EMPLOYEE REPRESENTATION

### 1. Scope and Purpose

The object or purpose of this Plan of Employee Representation is to promote, in every reasonable and practicable way, the well-being of the Employees and the best interest of the Commission with respect to all matters of common concern. The Plan itself is designed to establish a mutual policy which will accomplish these objectives.

1. (*a*) *Policy:*

Under this Plan both parties pledge themselves to co-operate in an unprejudiced effort to understand and appreciate each other's problems, difficulties and points of view and in a spirit of conciliation and fairness, to discuss and work out a mutually satisfactory and beneficial solution of those matters which come within the scope of the Plan as more particularly set out in (*b*).

1. (*b*) *Scope:*

All matters of common concern affecting the well-being of the Employees, either individually or collectively, come within the scope of this Plan, such, for example, as wages, working conditions and all plans or projects designed to promote the mutual benefit of the Commission and its employees.

Such matters pertaining to the Commission's business, its operations and the relation between those operations and the Employees, as the Commission may desire to submit, also come within the scope of the Plan.

### 2. Reservations and Safeguards

2. (*a*) *Scope:*

Nothing in this Plan of Employee Representation shall alter, prejudice or affect in any way whatsoever:

2. (*a*) (1) The rights, privileges or obligations of either the Commission or its Employees under the Industrial Disputes Investigation Act or any Federal or Provincial Legislation.

2. (*a*) (2) The right of any employee to deal directly with the Commission in matters pertaining to him or her individually.

2. (*a*) (3) The Commission's final decision on any matter involving the rights and responsibilities of Management.

2. (*b*) *No Discrimination Against Employee Participants in the Plan:*

No Employee Representative or employee serving, acting, or making a request or suggestion under or pursuant to any provision of this Plan shall be discriminated against on account of anything said or done in connection with or towards the carrying out of the provisions or purposes of the Plan; nor shall any such participation in the Plan prejudice his or her standing as an employee of the Commission. In the event of any such discrimination or prejudice being established, the Commission shall take all necessary steps to remedy

the situation and cause such discrimination or prejudice to cease.

2. (*c*) *Appeal Against Discrimination:*

Any Employee Representative or employee who feels that he or she has suffered discrimination shall have the right to seek redress either by appeal to the proper Employee Representative, acting under the Plan, or by an appeal to the Management through the proper lines of organization.

2. (*d*) *Violations of the Plan:*

Any violation of the terms or provisions set forth in the Plan, by either Management or Employees, shall be investigated by a Special Joint Committee as provided for in the Plan. The person or persons deemed to have violated the terms or provisions of the Plan shall not be included in this Committee. The findings of this Special Joint Committee shall be reported to the regular Joint Conference Committee at the same level.

2. (*e*) *Duration:*

This Plan shall go into effect when approved by the Commission and signed by the Employee Representatives and shall remain in effect unless or until terminated by a resolution of the Commission or by a majority vote of the Participating Employees.

In case of action by the Commission, one year's notice of this action shall be given by the Management Representatives at a meeting of the General Joint Conference Committee.

In the case of the Participating Employees, a referendum vote of the Participating Employees may be held on a resolution of the General Committee of Employee Representatives. If this vote is in favor of cancellation of the Plan, notice of this shall be given at the meeting of the General Joint Conference Committee and shall not go into effect for a period of one year from such notice.

### 3. General Administrative Considerations

3. (*a*) *Submitting Matters for Consideration Under the Plan:*

Employees who desire to offer comments or suggestions or to submit requests, complaints or protests to be dealt with under this Plan, shall submit them through their proper Representatives and shall be advised through them as to the disposition of the matters so submitted. When the Employee Representative deems it advisable to do so, he may require the employee to submit his requests for consideration in writing.

3. (*b*) *Assistance from Employees:*

Any employee having special knowledge of, or being personally interested in, any matter under discussion or consideration may be called upon to assist the Employee Representatives in their duties with respect to the provisions of the Plan and such employees shall have the same protection as provided for Employee Representatives.

3. (*c*) *Meetings on Commission Time:*

Meetings of Committees of Employee Representatives may be held on the Commission time.

3. (*d*) *Facilities and Expenses:*

The Commission shall provide the necessary facilities for Committee meetings and shall bear all necessary and proper expenses involved in the operation of the Plan.

3. (*e*) *Time Off:*

The Commission shall make no de-

duction in pay for such reasonable time off as may be necessary for Employee Representatives to perform their duties as such.

3. (*f*) *Mutual Appreciation of Requirements:*

All meetings of the Committees of Employee Representatives and all expenses incurred in the proper operation of the Plan, including time off for the Employee Representatives to perform their duties as such, shall be governed by a mutual appreciation of the requirements.

Prior to taking time off to attend to his duties, the Employee Representative shall obtain the consent of his Department Head for the time off. All expenses incurred in carrying out these duties shall be approved in the usual Commission routine, before being paid.

## 4. Explanatory Outline of the Scheme of Representation and Contacts

NOTE: This clause is inserted for the purpose of making the inter-relation of the subsequent clauses easier to follow and not for the purpose of definitely specifying any of the details of the Plan.

Under this Plan of Employee Representation, the territory served by the Commission is divided into districts, roughly equal to the number of Participating Employees having headquarters therein. Each district is again divided into voting units; the number of Participating Employees contained in each voting unit depends upon their distribution throughout the district, which very largely governs the problem of representation. (The Districts and Voting Units are defined in Appendix 1). Each voting unit is represented by one Participating Employee called the Employee Representative. The Employee Representative is elected biennially by a final ballot following a primary election of candidates, all under the control and supervision of the employees themselves. (Clause 10).

No formal scheduled meetings of the Participating Employees are provided for under the Plan, although it is intended that Employee Representatives shall make such contacts with the employees whom they represent as may be desirable and necessary in the carrying out of the Plan.

Employee Representatives meet monthly or bi-monthly in District Committee and at their first meeting, select a District Chairman and a District Secretary for a period of one year. The Chairman of the District Committees meet in General Committee quarterly or semi-annually, selecting their officers at their first meeting and these officers serve for one year. (Clause 7).

Scheduled Joint Conferences between District Committees and District Representatives of Management, take place monthly or bi-monthly and between the General Committees and the Representatives of the Commission quarterly or semi-annually. Special Joint Committees may, at any time, be formed at any level to discuss specific matters of immediate urgency. (Clause 9 (g).)

Thus contacts between the Employees and the Management for discussing such matters of common concern and interest as may be necessary and desirable in the carrying out of the Plan, occur in four ways:

4. (a) By direct meetings between Employee Representatives and the Supervisory Representatives of Man-

agement on the initiative of either. (6 (a) (2).)

4. (b) By monthly or bi-monthly joint conferences between the District Committees and the District Representatives of Management. (9 (b).)

4. (c) By quarterly or semi-annual General Joint Conferences between the General Committee of Employee Representatives and the Commission Representation. (9 (c).)

4. (d) By meetings in Special Committees for special purposes. (9 (g).)

5. PARTICIPATING EMPLOYEES

For the information and guidance of the District Joint Conference Committee in determining those who are eligible as Participating Employees under this Plan, the following general definition of Participating Employee will ordinarily govern.

All employees below the rank of those Supervisory Employees who exercise control of wages or salaries and working conditions of those under their supervision in the sense of their having the responsibility to recommend changes in rates of pay, promoting, dismissals, etc., shall ordinarily be eligible under this Plan.

In exceptional cases the District Joint Conference Committee is empowered to make special rulings.

6. EMPLOYEE REPRESENTATIVES

Employee Representatives shall be elected from the Participating Employees of the Commission to represent their various voting units, as outlined in this Plan.

6. (*a*) *Duties of Employee Representatives:*

Employee Representatives carry the employee responsibilities for the successful operation of the Plan. They should understand its purposes and method of operation and use unbiased judgment in performing their duties as Representatives. The Employee Representatives shall:

6. (*a*) (1) Represent the members of their voting units on the District Committee of Employee Representatives.

6. (*a*) (2) Represent the members of their voting units with the Management.

6. (*a*) (3) Represent the Participating Employees on Special Committees when appointed.

6. (*a*) (4) Familiarize themselves with the provisions of the Plan, in order that they may be able to discuss them intelligently.

6. (*a*) (5) Contact with members of their voting units as frequently as is desirable and necessary.

6. (*a*) (6) Present the views of the Management to the members of their voting units and make special efforts to keep them informed as to the progress of matters under consideration and promptly inform them as to the results of Committee meetings.

6. (*a*) (7) Take up with Management and endeavour to settle in a satisfactory manner, matters which affect the members of their voting units, individually or collectively, acting either at their own discretion and initiative or upon receipt of a request in writing.

6. (*a*) (8) Report to the District Secretary the disposition of matters which they have dealt with outside of Committee Meetings.

6. (*a*) (9) Respect the confidence of Employees and Management in matters of a personal or confidential nature.

6. (*a*) (10) Use their own initiative and judgment while acting on behalf of members of their voting units.

## 7. Committees of Employee Representatives

7. (*a*) *District Committee of Employee Representatives:*

7. (*a*) (1) The District Committee of Employee Representatives shall be composed of those Representatives elected from the voting units in a District.

7. (*a*) (2) The District Committees of Employee Representatives shall elect annually from their own number, a Chairman and a Secretary, who shall hold their respective offices for one year and until their successors are elected.

7. (*a*) (3) The District Committees of Employee Representatives shall meet monthly or bi-monthly, immediately preceding the District Joint Conference Committee meeting.

7. (*b*) *Duties of District Chairman:*

The District Chairman shall:

7. (*b*) (1) Preside at meetings of the District Committee of Employee Representatives.

7. (*b*) (2) Co-ordinate the activities of the Employee Representatives.

7. (*b*) (3) Call special meetings of the District Committee of Employee Representatives upon the request or with the consent of the majority of the members of the District Committee of Employee Representatives.

7. (*b*) (4) Attend all meetings of the General Committee of Employee Representatives and General Joint Conference Committee.

7. (*c*) *Duties of District Secretary:*

The District Secretary shall:

7. (*c*) (1) Attend all meetings of the District Committee of Employee Representatives.

7. (*c*) (2) Prepare agenda for District Joint Conference Committee Meetings.

7. (*c*) (3) In the temporary absence of the Chairman, call the meeting to order and hold an election for a Temporary Chairman.

7. (*c*) (4) Perform all duties incidental to the office of Secretary.

7. (*c*) (5) In the temporary absence of the Chairman, represent the District at meeting of the General Committee of Employee Representatives and General Joint Conference Committee.

7. (*d*) *General Committee of Employee Representatives:*

7. (*d*) (1) The General Committee of Employee Representatives shall be composed of the Chairmen of the several District Employee Committees.

7. (*d*) (2) The General Committee of Employee Representatives shall elect annually from their own number, a Chairman and a Secretary, who shall serve for one year and until their successors are elected.

7. (*d*) (3) The General Committee of Employee Representatives shall meet quarterly or semi-annually, immediately preceding the General Joint Conference Committee Meetings.

7. (*e*) *Duties of General Chairman:*

The General Chairman shall:

7. (*e*) (1) Preside at meetings of the General Committee of Employee Representatives.

7. (*e*) (2) Co-ordinate the activities of the District Chairmen throughout the Commission.

7. (*e*) (3) Call special meetings of

the General Committee of Employee Representatives upon the request or with the consent of two (2) or more District Chairmen.

7. (*e*) (4) Be a member, ex-officio, of every District Committee of Employee Representatives in the Commission.

7. (*f*) *Duties of General Secretary:*

The General Secretary shall:

7. (*f*) (1) Attend all meetings of General Committee of Employee Representatives.

7. (*f*) (2) Prepare agenda for General Joint Conference Committee Meetings.

7. (*f*) (3) In the temporary absence of the General Chairman, call the meeting to order and hold an election for a Temporary Chairman.

7. (*f*) (4) Perform all duties incidental to the office of the Secretary.

8. MANAGEMENT REPRESENTATIVES

8. (*a*) *Duties of Management Representatives:*

Management Representatives carry the responsibilities of Management for the successful operation of the Plan. They should understand its purposes and method of operation and use unbiased judgment in performing their duties as Representatives.

The Management Representatives shall:

8. (*a*) (1) Encourage discussion on all matters taken up at the Joint Conference Meetings, whether introduced by Employee Representatives or Management Representatives.

8. (*a*) (2) Obtain additional data when necessary to complete a thorough discussion of any specific subject.

8. (*a*) (3) Give prompt and definite decision on all matters within their authority.

8. (*a*) (4) Forward promptly to the proper Management Official all matters beyond their authority and to do their utmost to obtain decisions.

8. (*a*) (5) Participate in the preparation and distribution of the minutes of Joint Conference Meetings.

9. JOINT CONFERENCE COMMITTEE MEETINGS

9. (*a*) *Joint Conference General:*

Joint Conference Committee Meetings shall be carried out in the following manner:

9. (*a*) (1) The Management Representatives and the Employee Representatives shall meet together to form Joint Conference Committees as herein outlined.

9. (*a*) (2) The number of Management Representatives attending Joint Conferences shall not exceed the number of Employee Representatives. Where necessary, Management Representatives may have advisers attending Joint Conferences, but these advisers shall not have the status of Management Representatives.

9. (*a*) (3) The members of each Joint Conference Committee shall elect, from their own number, a chairman, who will act only for the meeting at which chosen.

9. (*a*) (4) The Management will provide a Recording Secretary, satisfactory to both parties, to act only at the meeting for which appointed. This Recording Secretary shall not take part in discussions, but will record the proceedings.

9. (*a*) (5) Joint Conference Committee Meetings shall be definitely scheduled and may be postponed only by mutual consent of the parties concerned.

9. (*a*) (6) The Joint Conference

Committee shall discuss such matters of mutual concern as may be introduced by any member.

9. (*a*) (7) The Joint Conference Committee shall endeavour to reach an understanding insofar as they have authority to act. If an understanding cannot be reached, the question shall be referred to the next upward level of Management or Joint Conference Committee.

9. (*a*) (8) Special Meetings of Conference Committee may be called by either the Chairman of the Employee Committee or the Senior Management official concerned. The party calling the meeting shall give written notice of the purpose. The date and place are to be mutually agreed upon.

9. (*a*) (9) If an understanding cannot be reached in General Joint Conference Committee, the matter may be referred to the Commission by action of the Committee. If, in the opinion of the majority of Employee Representatives, it is desirable for Employee Representatives to personally present the case of the Employees to the Commission, this privilege shall be accorded them.

9. (*a*) (10) The Secretary of the Employees' Committee, of the group concerned, shall be responsible for notifying the members of the Joint Conference Committee as to the time and place at which the meetings are to be held.

9. (*b*) *District Joint Conference Committee Meetings:*

District Joint Conference Committee Meetings shall be held monthly or bi-monthly before the fifteenth day of the month. Definite dates for such meetings shall be scheduled locally, by the Joint Conference Committee and a copy of such schedule shall be forwarded to the Chairman of the General Committee of Employee Representatives.

The District Joint Conference Committee shall, in addition to its other duties, determine those who are eligible to participate in the Plan, being guided by the definition of Participating Employee as given in Clause 5. In exceptional cases, the Committee is empowered to make special rulings.

9. (*c*) *General Joint Conference Committee Meetings:*

General Joint Conference Committee Meetings shall be held quarterly or semi-annually. Definite dates of such meetings shall be scheduled by the General Joint Conference Committee.

9. (*d*) *Order of Business at Joint Conferences:*

Opening of meeting by Employee Committee Chairman.
Introduction of new members.
Election of Officers.
Adoption of Minutes of previous meeting.
Schedule of Meetings.
Unfinished Business.
Correspondence.
New Business—Employees.
New Business—Management

9. (*e*) *Minutes of Joint Conferences:*

Minutes shall be prepared of Joint Conference Committee Meetings and shall contain a clear and concise report of the discussions. The minutes shall be prepared by the Employee Representatives' Secretary, together with a Management Representative, and shall be made from the notes taken by the Recording Secretary, but shall not be a verbatim report. Names shall be mentioned in this report un-

less otherwise requested by the individual concerned.

Minutes of Joint Conference Committee Meetings shall be prepared with utmost dispatch and should be distributed not later than ten (10) days after the meeting has taken place.

Minutes of Joint Conference Committee Meetings before being circulated, shall be signed by the Secretary of the Committee of Employee Representatives and the Management official who collaborated in their preparation. When adopted, they shall be signed by the Chairman.

9. (*f*) *Distribution of Minutes of Joint Conferences:*

Copies of Minutes of the District Joint Conference Committee Meetings shall be sent to the Employee Representatives within the district and also to the Chairman of the General Committee of Employee Representatives. Sufficient copies shall also be prepared to meet the Management's requirements.

Copies of minutes of the General Joint Conference Committee Meetings shall be sent to every Employee Representative. Sufficient copies shall also be prepared to meet the Management's requirements.

9. (*g*) *Special Committees:*

Special Committees composed of the Chairman of the District Committee of Employee Representatives and one other employee selected by him, may be formed at any time in any District, to meet with Management to review cases of dismissal and other disciplinary action and to review qualifications and eligibility of employees regarding promotion, when, in the opinion of the Employee Representatives, such a review appears necessary or desirable.

10. ELECTIONS

Each voting unit, as established from time to time, shall elect from its own number a Representative. Ballots shall be in the form set forth in the Appendix.

10. (*a*) *Eligibility:*

To be eligible to stand for election as an Employee Representative, a Participating Employee must:

10. (*a*) (1) Be of the full age of 21 years.

10. (*a*) (2) Have had not less than two years' continuous service with the Commission.

10. (*a*) (3) Be an employee of the Commission at the time of election.

10. (*b*) *Elections—General:*

10. (*b*) (1) Management shall not interfere with or in any way attempt to influence the selection or election of Employee Representatives.

10. (*b*) (2) A Participating Employee to be eligible to vote must have had 12 months' aggregate employment with the Commission and be on the Commission's regular payroll at the time of voting.

10. (*b*) (3) In the selection of Representatives, voters should bear in mind that the person so elected is eligible for the office of Chairman in the District or General Committee.

10. (*b*) (4) The elections in each district shall be supervised and conducted by a Committee of three (3) composed of the District Chairman and two (2) scrutineers appointed by the District Committee.

10. (*b*) (5) The Management shall supply ballots and such assistance as may be requested by the Employee Representatives.

10. (*b*) (6) Upon petition of five (5) or more employees to the District Committee of Employee Representatives, consideration shall be given to the reconstitution of new voting units.

10. (*b*) (7) Any reconstitution of voting units or creation of new voting units shall be made only on the recommendation of the District Committee of Employee Representatives subject to approval by the General Committee of Employee Representatives and ratification by District Joint Conference Committee.

10. (*b*) (8) Lists shall be prepared by the District Committee of Employee Representatives, indicating employees who are eligible for the office of Employee Representatives and those eligible to vote. These lists shall be circulated and posted at least ten (10) days before the Primary Elections.

10. (*b*) (9) The first election shall be held in the year 1935 and shall be governed by Appendix. There shall be no general election in 1936. The 1937 election and all subsequent elections shall be governed by the Clauses which follow.

10. (*b*) (10) Employee Representatives shall be elected for a period of two (2) years and shall be eligible for re-election. After serving for two consecutive full terms, they shall not be eligible for re-election for the next succeeding term.

10. (*b*) (11) Approximately one-half the Employee Representatives in any District shall be elected in alternate years; to this end, starting with the 1937 election, odd numbered voting units shall hold elections in odd years and even numbered voting units in even years.

10. (*c*) *Primary Elections:*

10. (*c*) (1) Primary or nominating elections shall take place during the first two weeks of June. All employees eligible to vote shall receive ballots between June 1st and 5th, indicating the voting unit to which they belong. These ballots shall be completed and returned not later than June 13th.

10. (*c*) (2) Results of the Primary Elections shall determine the candidates for the Final Elections. These candidates shall be the four persons who receive the largest number of votes cast in their respective voting units and who consent to stand for election.

10. (*d*) *Final Elections:*

Final election ballots shall be distributed between June 15th and 20th and returned completed not later than June 30th. The candidate receiving the largest number of votes shall be elected Employee Representative for a term of two (2) years or until a successor is elected. An exception shall be made in the case of the first election which shall be conducted as laid down in the Appendix. The names of the elected Representatives shall be posted and the Management notified.

10. (*e*) *Special Elections and By-Elections:*

Special Elections and By-Elections, when necessary, shall be conducted along the lines of procedure as described in the Primary and Final Election Clauses in this Plan.

10. (*f*) *Ballots:*

10. (*f*) (1) Ballots not marked in accordance with the directions printed thereon shall be null and void.

10. (*f*) (2) Tie votes shall be decided by lot.

10. (*f*) (3) All ballots shall be held in safe keeping for thirty (30) days following the date of election.

10. (*f*) (4) If, within ten (10) days, following an election, any candidate makes a written demand for a recount, the ballot shall be recounted by special scrutineers appointed by the District Committee of Employee Representatives.

10. (*g*) *Vacancies:*

An Employee Representative shall be deemed to have vacated office upon:

10. (*g*) (1) Terminating employment with the Commission.

10. (*g*) (2) Being permanently transferred from one voting unit to another.

10. (*g*) (3) Appointment to supervisory position.

10. (*g*) (4) Recall.

10. (*g*) (5) Resignation as an Employee Representative.

In the event of an Employee Representative being permanently transferred to some other voting unit or being promoted, so as to become ineligible for the office of Employee Representative, thirty (30) days' grace shall be allowed in which to complete or arrange for completion of any matter or matters under consideration.

The Participating Employee who received the next highest number of votes to the Employee Representative who is vacating the office, at the last election held, shall be declared the successor to the Employee Representative, for the unexpired portion of the term, except where the Employee Representative has been recalled, in which case an election shall be held immediately.

10. (*h*) *Temporary Vacancy:*

In the event of an Employee Representative being unable to fulfill his duties for a prolonged period through sickness, accident or other cause beyond his control, the District Committee may appoint the Participating Employee, who had received the next highest number of votes at the last election.

10. (*i*) *Recalls:*

An employee or employees preferring complaints or charges against an Employee Representative shall set forth in writing the facts of the case and forward the same to the Chairman of the District Committee of Employee Representatives. The Chairman shall then call a Special Meeting of the District Committee of Employee Representatives. The Committee shall hear complaints and when considered sufficiently serious and well substantiated, it shall call for a ballot of the voting unit to determine whether the Representative against whom the charges are made shall be recalled.

Where the District Chairman has been presented with a petition signed by not less than two-thirds (2/3) of the members of a voting unit, requesting the recall of their Representative, he shall order a new election within that voting unit.

An employee or employees preferring complaints or charges against the Special Representative (of Northern Systems) shall set forth in writing the facts of the case and forward the same to the Chairman of the General Committee of Employee Representatives.

The Chairman shall then call a special meeting of the General Committee of Employee Representatives. The Committee shall hear complaints and when considered sufficiently serious and well substantiated, it shall call for a ballot of the voting units, to determine whether the Special Representative against whom the charges are made shall be recalled.

Where the General Chairman has been presented with a petition signed by not less than two-thirds (2/3) of the members of the voting units, requesting the recall of their Special Representative, he shall order a new election within the voting units.

10. (*j*) *Replacement of Officers:*

It shall be the prerogative of any Committee of Employee Representatives to replace their officers at any time by a majority vote, without recourse to the group represented by such officers. Replacement of an officer shall in no way affect his standing as an Employee Representative.

### 11. Amendments

11. (*a*) This Plan may be amended with the approval of the General Joint Conference Committee and the affirmative vote of not less than two-thirds (2/3) of all Employee Representatives and with formal approval of the Commission.

11. (*b*) Written suggestions for the amendment of this Plan may be made by an Employee, Employee Representative or Management Representative and forwarded as outlined herein.

11. (*c*) Suggestions originated by an Employee or an Employee Representative shall be forwarded to the District Secretary and considered at a meeting of the District Committee of Employee Representatives and forwarded through the General Committee of Employee Representatives for approval of the General Join Conference Committee. When approved by the General Joint Conference Committee, it shall be forwarded for final ratification of the Employee Representatives as provided for in Paragraph (a).

11. (*d*) Suggestions originated by Management shall be forwarded to the General Joint Conference Committee for consideration. When approved, they shall be forwarded for ratification by the Employee Representatives.

### Appendix I.

1. (*a*) There shall be six (6) Districts as detailed on the map, to be known as:

(1) Niagara Falls.
(2) Toronto-Hamilton.
(3) Niagara West.
(4) Toronto Head Office.
(5) Georgian Bay.
(6) Eastern Ontario.

1. (*b*) These Districts shall be divided into voting units as follows:—

(1) Niagara Falls.

(1) Ontario Power—O. P. Generating Station, Niagara Station, Thorold Station, Port Colborne Station, Welland R.P.D., Stamford R.P.D.

(2) General District Staff—District Office Staff, Linemen, General Stores, District Meter Dept.; District Bldg., and Canal Maintenance Staffs; Load Supervisors.

(3) Toronto Power—T.P. Generating Station, Transformer Station.

(4) Queenston Generating Station.

(5) DeCew Falls and Rural—DeCew Falls Generating Station and


Head Works and Substations, Lincoln Electric, Beamsville R.P.D.

(2) Toronto—Hamilton.

(1) Toronto, York, Cooksville.

(2) Forestry Dept. and Rural.

(3) Dundas—Hamilton.

(4) Construction Dept., Field Force.

(3) Niagara West.

(1) Guelph—St. Mary's.

(2) Brant—Woodstock.

(3) London—St. Thomas.

(4) Chatham—Sarnia.

(5) Essex.

(4) Toronto Head Office.

(1) Second Floor Accounting.

(2) Fourth Floor Accounting and Fyling Dept.

(3) Strachan Avenue Service Building Staff—Laboratory, Stores, Garage and Machine Shop, Salvage, Caretaking Staff.

(4) Fifth and Sixth Floors—Electrical Engineering Dept., Hydraulic Engineering Dept., Operating Dept., Meter Section located at Strachan Avenue.

(5) Purchasing Dept., Electrical Inspection Dept., Caretaking Staff, Municipal Dept., Construction Dept., Printing Dept., General Stenographers.

(5) Georgian Bay.

(1) Eugenia.

(2) Severn.

(3) Muskoka, Wasdells, Bala.

(4) Nipissing.

(5) Sudbury.

(6) Eastern Ontario.

(1) Trenton, Whitby, Fenelon Falls, Peterboro', Norwood.

(2) Campbellford, Madoc, Hastings.

(3) Belleville.

(4) L.H. & Q. Systems with Ottawa and Kingston.

(5) Chats Falls and Madawaska.

1. (*c*) There shall be one voting unit in the Abitibi District and one in the Thunder Bay District, the latter to embrace Rat Rapids and Ear Falls. The Representatives

elected by these voting units shall attend the meetings of the General Employee Committee and the General Joint Conference, as Advisers to a Special Representative resident in or near Toronto, who will be elected jointly by these two voting units, and who will have all of the powers of a District Chairman at these meetings. The Representatives of these two voting units have the right to discuss any matter at meetings, with voting power vested in their Special Representative.

FINAL ELECTION BALLOT
Employee Representative for
District No. . . . Voting Unit No. . . .
Vote for one only.

| | |
|---|---|
| Arthur Jones | |
| William S. Smith | |
| Peter J. Green | |
| Henry T. Brown | |

Specimen for Ballots.

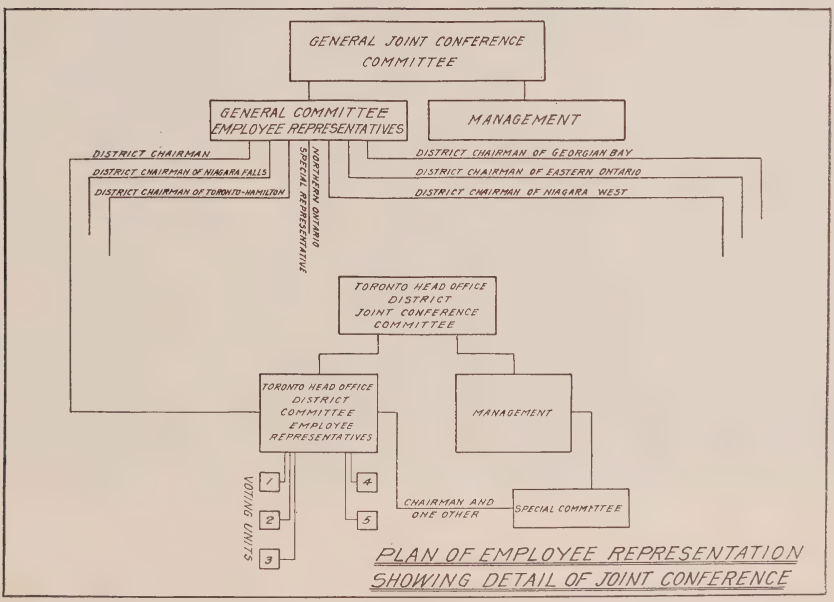
1. (*d*) The initial, primary and final elections shall be conducted in a manner similar to that employed in the election of the Employee Representatives to the Organizing Committee, with the exception that there shall be scrutineers representing the Participating Employees.

1. (*e*)

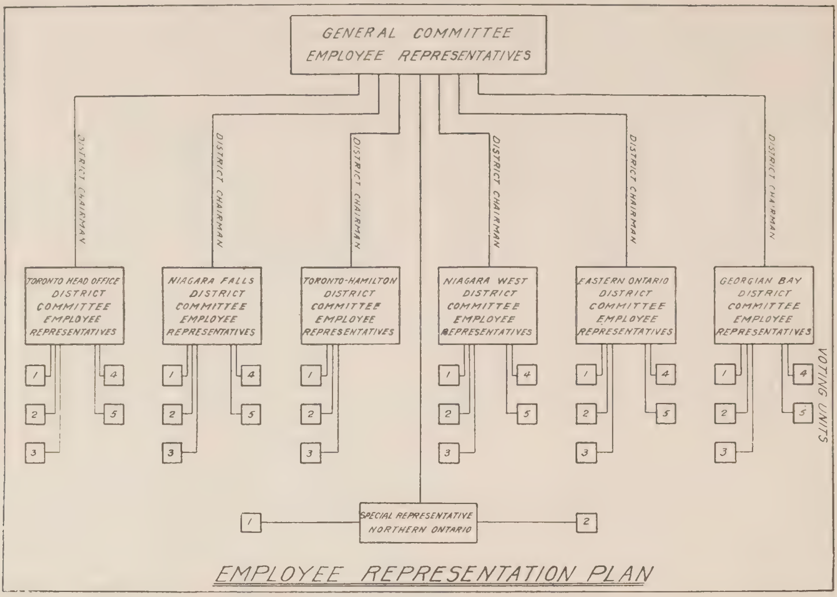
PRIMARY ELECTION BALLOT
Nominating Employee Representatives for
District No. . . Voting Unit No. . . .

Print on the lines provided below, the names of the four (4) Participating Employees, eligible for office, in your voting unit, whose names you would like to appear on the Final Ballot:

. . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . .



PLAN OF EMPLOYEE REPRESENTATION SHOWING DETAIL OF JOINT CONFERENCE




*Employee Representation Committee. Standing:—G. E. Whitaker, James Poppleton, H. C. McElrath, W. A. Armstrong, and A. C. Holcombe. Sitting:—R. H. Roe, E. B. Dustan, H. Duncan and W. B. Ford.*

# Thawing of Ice in Water Pipes by Electricity

By W. P. Dobson, Chief Testing Engineer, and W. B. Buchanan, Testing Engineer, H.E.P.C. of Ont.

*(Paper presented at the fifteenth annual meeting of the Canadian Section of the American Waterworks Association at London, March 27, 28 and 29, 1935.)*

THE continuity of water supply to every customer of a waterworks utility is so taken for granted that an interruption of service to any one customer results in a near panic in the household affected, and urgent demands on the Waterworks Department for renewal of service. In the case of failure of electricity supply due to lightning, sleet storms or other unusual weather conditions, the damaged equipment is usually accessible and interruptions to service for repairs seldom cause more inconvenience than a temporary resort to wax candles and delicatessen meals. However, unusually severe winters have resulted in widespread freezing of service pipes, which, owing to their inaccessibility, would probably have remained frozen until April, had not enterprising waterworks and electric utility men joined forces in devising means of thawing ice in water pipes by electricity. Due to its simplicity, low cost, speed and effectiveness, this method has been almost universally adopted and the past twenty years' experience has demonstrated that it is not unduly hazardous to the public, the operators or the equipment and property involved. The use of electricity in even the most simple operations demands some precautions, however, and it is the purpose of this paper to point out some of the hazards to life or property which may exist if the necessary precautions are overlooked.

*Design and Rating of Equipment:*

Current for the thawing of ice in water pipes is generally obtained from the secondary of a transformer, the primary of which is connected to a primary line at 1,100 to 4,400 volts, through fused switches and an ammeter. A convenient portable equipment may be assembled from suitable distribution transformers mounted on a truck, the switches being carried on a crossarm above the transformers. The transformer secondary rating should be such that it will deliver:

(a) Currents of 200 to 600 amperes for thawing iron pipes from ¾ inch to 6 inches diameter.

(b) Sufficient voltage to maintain the desired current through the maximum length of pipe to be heated in one operation.

Modern distribution transformers are capable of delivering twice full load current for intermittent periods up to one-half hour, hence two 10 kv-a. transformers with 115 volt secondaries paralleled will deliver up to 350 amperes at 115 volts for intermittent service. For thawing house services, 55 volts is usually sufficient which is conveniently obtained by

connecting the primaries in series and secondaries in parallel. The current may be indicated by an ammeter in the primary or current transformer and ammeter in the secondary circuit and may be regulated by means of a secondary salt water rheostat, or by coiling up the spare secondary leads to form a reactance coil. In many cases, it has been found satisfactory to use 55 volts on house service thawing without any regulation other than the fixed resistance of the secondary leads.

In addition to the pipe-thawing transformers for connection to a primary supply which are supplied by a number of Canadian manufacturers, there are available units up to 5 kv-a. for connection to 110/220 volt supply. For thawing inside pipes, ratings as low as 0.75 to 1.5 kv-a. are recommended. These, having maximum secondary voltages of 5 and 10 volts respectively, are limited to short runs of pipe, but to a large extent eliminate the fire and shock hazard. Special care should be taken, however, that the use of equipment of higher capacity and secondary voltages up to 50 volts be not placed in charge of inexperienced men who do not themselves appreciate its dangers and are, therefore, in no position to safeguard the public.

Portable arc-welding machines have been used for pipe-thawing, which provide for a nicety of current control, but the cost of such equipment is several times that of an equivalent alternating current unit. Electrolysis from the use of heavy d.c. currents for the short periods usually involved in pipe thawing should not be objectionable. There are cases where, to prevent a recurrence of freezing, a current is maintained in the pipe for long periods. The use of direct current in such cases would be objectionable.

A modification of this equipment in the form of a gasoline-engine driven alternating current generator permits pipe thawing in locations where no electricity supply exists. A typical machine of this type employs a Ford motor driving a 500 ampere, 115 volt, a.c. generator at 1,800 rev. per min.

A study of present practice and the accumulated experience of more than 3,000 thawing operations in various municipalities throughout Ontario show clearly the high degree of safety to life and property maintained in this work. It may be well, however, to describe in some detail the precautions which were necessary to achieve this result.

*Damage to Pipes or Fittings.*

In the case of ordinary ¾-inch service pipes, currents up to 300 amperes should cause no damage in the piping except at rubber-gasketed unions. This may be avoided by providing an electrical by-pass around such fittings. Connections to the operating rod of a shut-off valve should be avoided. The most difficult services to thaw are those using lead or copper pipe coupled to iron pipe, since the heavy currents necessary to thaw ice in the lower resistance copper or lead pipe may damage the iron pipe. Such a case requires careful handling and for copper pipes, may require currents in excess of the usual 300 to 600 ampere supply. It has been noticed in several cases that a thawing operation loosens scale or rust in the pipes which may result in blocking a valve.

In thawing mains of 3 to 6 inches diameter, currents of 400 to 600 amperes may be required for from fifteen minutes to over an hour and attempts to thaw such mains by connecting to a service pipe on each side of the frozen section is likely to damage the smaller pipe. If it is impossible to make connections to hydrants or to the main itself, two or more services should be connected by jumpers in order to properly distribute the current. A clamp-on ammeter provides a convenient means of checking such current distribution. The use of butt joints, and various gasket materials, in mains, may result in damage at the joints. In most cases, such concentration of heat at joints will be indicated by an erratic ammeter reading as voltage is applied, indicating intermittent breakdown of the joint insulation.

The finding of burst pipes after thawing sometimes throws suspicion on the electric thawing operation as the cause, but the possibility of generating sufficiently high temperature steam to develop bursting pressure is extremely remote.

*Damage to Gas Piping and Electric Wiring.*

To guard against overheating of gas pipes, or sparks adjacent to gas pipes or meters with their attendant fire hazard, all connections between the gas and water piping systems should be removed, and all crossovers or other points of contact insulated during the application of current.

The electrical neutral conductor, when bonded to the water piping system, may divert a large part of the current and this has been known to cause fire during thawing operations. Such diversions may be conveniently checked by means of a clip-on ammeter, and may be prevented by removal of the neutral connection. In case of breakdown of high voltage insulation of the pipe-thawing transformer, the neutral connections at nearby houses to the same water main should protect against hazardous voltages on the water piping system. Where an existing distribution transformer is being used for pipe thawing, it is imperative that the neutral connection at the transformer secondary be removed, otherwise current will feed back through the secondary neutral to adjacent water pipe connections, and may seriously overload the transformer.

Failure to remove neutral connections from a service pipe will frequently cause several telephones in the neighbourhood to ring while the thawing operation proceeds. Not only is this annoying, but it may be dangerous since it indicates a raising of ground potential in the district affected to between 40 and 50 volts.

*Prevention of Electric Shock.*

When a primary supply to the thawing transformer is used, the primary connections should be made by a qualified lineman, and where any temporary high voltage conductors are accessible to passers-by or curious children, a man should remain on guard continuously.

On the secondary side, the voltage will usually be 110 volts or less, but due to the damp locations and large areas of pipe exposed, even this voltage may be dangerous. Residents in the house whose service is being

thawed should be warned to keep clear of all water piping and electrical appliances. It is quite conceivable that a hazardous potential may exist between a kitchen tap and a grounded electric stove frame, or between the water supply pipes and drain pipes, especially if the electrical neutral has been removed from the water piping to prevent it overheating.

Poor clamp connections, insulated joints, or other discontinuity in the secondary circuit may cause steep voltage gradients, necessitating the use of rubber gloves in handling any secondary connections and guarding of exposed parts of the circuit from accidental contact.

Special precaution is necessary in thawing pipes connected to watering troughs or other farm equipment with which livestock may come in contact, since voltage gradients which are harmless to humans may be fatal to livestock.

A satisfactory pipe-thawing operation consists not only of restoring a flow of water through the pipe, but in preventing the water freezing again if at all possible. When water in a pipe freezes, even though the flow is very small, the surrounding soil will be colder than the pipe itself, and frost will have penetrated a certain distance below the pipe. If sufficient current is used to thaw the ice along the inner surface of the pipe in two or three minutes, it is evident that the surrounding soil will remain below freezing point. If sufficient water is available to permit the constant running of a tap, the pipe may remain clear. In addition to recommending the constant running of water for at least a few hours, it may be worth while to continue the electric heating process until the entire pipe and surrounding soil have been warmed. An extra fifteen minutes on the job may save a return call and a dissatisfied customer.

It is hoped that some of the foregoing remarks may arouse discussion among those responsible for electrical thawing operations, and that they may add their experience to the general fund of information from which safe practices will evolve.

NOTE: This paper was submitted for technical discussion and enlightenment and nothing stated therein should be regarded as official pronouncement of the employers of the authors nor interpreted as comment for or against any rule or regulation that might have application to any particular place or condition.

*Cameron Falls Generating Station, Nipigon System.*

# Appliance Surveys—Urban and Rural

By G. J. Mickler, B.A.Sc., Sales Department, H.E.P.C. of Ont.

ATTACHED hereto are tables showing the results of surveys of appliances in use by Hydro consumers, both Urban and Rural as follows:

Table No. 1—Estimated number of major electrical appliances in use among Domestic consumers at the end of 1934.

Table No. 2—Comparison by systems of saturation of appliances in use among Domestic consumers.

Table No. 3—Number of major electrical appliances in use by Rural Hamlet consumers covered in the recent survey.

Table No. 4—Number of major electrical appliances in use by Rural Farm consumers covered in the recent survey.

Table No. 5—Comparison of the saturation of appliances used in the homes of Rural and Urban consumers.

The estimated number of appliances in use among domestic consumers was arrived at by totalling the returns received from about seventy-five per cent. of the municipalities and interpolating from them the number in use by all domestic consumers.

The municipalities do not make a complete survey each year but by occasional test checks and surveys keep their information fairly accurate. Their yearly reports of appliances in use at the end of the year are therefore as correct as could be expected.

TABLE 1.

TABLE SHOWING ESTIMATED NUMBER OF MAJOR ELECTRICAL APPLIANCES IN USE AMONG DOMESTIC HYDRO CUSTOMERS AT END OF 1934.

| Appliances | Number | Per cent. Saturation |
|---|---|---|
| Electric Ranges | 122,794 | 26.1 |
| Hot Plates | 66,282 | 14.1 |
| Washers | 183,081 | 38.9 |
| Vacuum Cleaners | 134,323 | 28.6 |
| Water Heaters—Flat Rate | 28,994 | 6.2 |
| Water Heaters—Metered | 42,381 | 9.0 |
| Grates | 32,607 | 6.9 |
| Air Heaters (Port) | 140,505 | 29.9 |
| Ironing Machines | 6,841 | 1.45 |
| Irons | 439,765 | 93.6 |
| Refrigerators | 51,309 | 10.9 |
| Toasters | 245,283 | 52.2 |
| Grills | 42,869 | 9.1 |
| Furance Blowers and Oil Burners | 12,986 | 2.7 |
| Air Conditioner | 733 | .15 |
| Radios | 285,440 | 60.7 |
| No. of consumers | 469,933 | .. |

The number of appliances in use among hamlet and farm consumers (not including summer consumers) in the rural power districts are the actual results from surveys made this year and cover only those consumers which were visited. No attempt was made to arrive at the total for all rural consumers. Since eighty per cent. of all rural consumers were surveyed the results as shown are a fair indication of the appliances in use by rural consumers.

## TABLE NO. 2

### URBAN DOMESTIC CONSUMERS

### TABLE SHOWING PER CENT. SATURATION OF ELECTRICAL APPLIANCES IN EACH SYSTEM

| | All Systems | Niagara System | Geo. Bay System | Eastern System | T.B. System |
|---|---|---|---|---|---|
| Ranges | 26.1 | 26.3 | 16.5 | 26.7 | 42.0 |
| Hot Plates | 14.1 | 12.4 | 25.8 | 14.5 | 48.4 |
| Washers | 38.9 | 41.0 | 30.8 | 28.5 | 48.8 |
| Vacuum Cleaners | 28.6 | 30.7 | 11.1 | 21.6 | 36.4 |
| Water Heaters, Flat Rate | 6.2 | 6.5 | 1.1 | 4.4 | 19.0 |
| " " Metered | 9.0 | 6.9 | 6.0 | 21.8 | 15.9 |
| Grates | 6.9 | 7.8 | 1.5 | 3.9 | 6.4 |
| Air Heaters | 29.9 | 31.9 | 16.1 | 23.3 | 31.6 |
| Ironing Machines | 1.45 | 1.6 | .7 | .9 | 1.5 |
| Irons | 93.6 | 94.3 | 80.1 | 93.9 | 96.7 |
| Refrigerators | 10.9 | 12.2 | 5.8 | 6.3 | 3.8 |
| Toasters | 52.2 | 51.5 | 47.1 | 56.3 | 66.4 |
| Grills | 9.1 | 7.2 | 10.2 | 19.6 | 11.7 |
| Furnace Blowers and Oil Burners | 2.7 | 2.8 | 2.6 | 2.7 | 1.3 |
| Air Conditioners | .15 | .2 | .03 | .2 | .2 |
| Radios | 60.7 | 61.7 | 55.5 | 56.2 | 65.5 |
| Number of Consumers | 469,933 | 374,052 | 24,551 | 61,621 | 9,709 |

## TABLE NO. 3

### Rural Power District Hamlet Consumers

| | Niagara System | | Georgian Bay System | | Eastern System | | All Systems | |
|---|---|---|---|---|---|---|---|---|
| | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation |
| In The Barn | | | | | | | | |
| Elec. Motor | 752 | 3.8 | 91 | 5.1 | 218 | 4.4 | 1,062 | 3.9 |
| " Pump | 167 | .8 | 13 | .7 | 47 | .9 | 232 | .8 |
| " Grain Grinder | 1 | ..... | 2 | .1 | 3 | ..... | 6 | ..... |
| " Milker | ..... | ..... | 2 | .1 | ..... | ..... | 2 | ..... |
| " Milk Cooler | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| " Cream Separator | 5 | ..... | 2 | .1 | 1 | ..... | 8 | ..... |
| " Churn | 3 | ..... | 2 | .1 | ..... | ..... | 5 | ..... |
| " Incubator | 21 | ..... | ..... | ..... | 5 | ..... | 26 | ..... |
| " Brooder | 7 | ..... | ..... | ..... | 5 | ..... | 12 | ..... |
| " Hot Beds | 1 | ..... | ..... | ..... | 1 | ..... | 2 | ..... |
| " W. Heaters (F.R.) | ..... | ..... | 1 | ..... | ..... | ..... | 1 | ..... |
| " " " (Met.) | 1 | ..... | ..... | ..... | 2 | ..... | 3 | ..... |
| " Misc. | 103 | .5 | 15 | .8 | ..... | ..... | 118 | .4 |
| In The Home | | | | | | | | |
| Elec. Range | 2,379 | 12.0 | 103 | 5.8 | 396 | 7.9 | 2,904 | 10.8 |
| " Hot Plate | 3,636 | 18.3 | 463 | 26.2 | 1,167 | 23.4 | 5,361 | 19.9 |
| " Washer | 8,116 | 40.1 | 621 | 35.1 | 1,731 | 34.7 | 10,616 | 39.4 |
| " Cleaner | 2,523 | 12.7 | 117 | 6.6 | 432 | 8.7 | 3,106 | 11.5 |
| " W. Heaters (F.R.) | 438 | 2.2 | 13 | .7 | 51 | 1.0 | 502 | 1.9 |
| " " " (Met.) | 350 | 1.8 | 10 | .6 | 59 | 1.2 | 425 | 1.6 |
| " Grate | 150 | .7 | 8 | .5 | 43 | .9 | 202 | .7 |
| " Port. Air Heater | 1,548 | 7.8 | 93 | 5.3 | 442 | 8.8 | 2,112 | 7.8 |
| " Refrigerator | 1,680 | 8.4 | 121 | 6.8 | 435 | 8.7 | 2,247 | 8.3 |
| " Hand Iron | 13,706 | 68.9 | 1,213 | 68.6 | 3,359 | 67.4 | 18,482 | 68.6 |
| " Ironer | 151 | .8 | 17 | 1.0 | 31 | .6 | 200 | .7 |
| " Toaster | 8,267 | 41.6 | 777 | 43.9 | 2,314 | 46.4 | 11,486 | 42.6 |
| " Radio | 11,687 | 58.7 | 983 | 55.6 | 2,820 | 56.6 | 15,691 | 58.3 |
| " Furnace Blower | 370 | 1.9 | 8 | .5 | 59 | 1.2 | 441 | 1.6 |
| " Sanitary System | 2,007 | 10.1 | 204 | 11.5 | 456 | 9.1 | 2,668 | 9.9 |
| " Motor | 176 | .9 | 3 | .2 | 15 | .3 | 410 | 1.5 |
| " Pump | 153 | .8 | 5 | .3 | ..... | ..... | 180 | .7 |
| " Misc. | 398 | 2.0 | 12 | .7 | ..... | ..... | 163 | .6 |
| Number of Consumers Covered | 19,891 | | 1,769 | | 4,984 | | 26,929 | |

Nipissing and Thunder Bay not shown but included in All Systems summary.

## TABLE NO. 4

### Rural Power District Farm Consumers

| | Niagara System | | Georgian Bay System | | Eastern System | | All Systems | |
|---|---|---|---|---|---|---|---|---|
| | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation | Number of Appliances | Per cent. of Saturation |
| **In The Barn** | | | | | | | | |
| Elec. Motor | 3,618 | 18.7 | 248 | 20.7 | 496 | 18.7 | 4,368 | 18.6 |
| " Pump | 3,108 | 16.1 | 142 | 11.8 | 327 | 12.3 | 3,602 | 15.4 |
| " Grain Grinder | 933 | 4.8 | 129 | 10.8 | 33 | 1.2 | 1,097 | 4.7 |
| " Milker | 464 | 2.4 | 12 | 1.0 | 132 | 5.0 | 611 | 2.6 |
| " Milk Cooler | 158 | .8 | 6 | .5 | 10 | .4 | 178 | .7 |
| " Cream Separator | 1,259 | 6.5 | 72 | 6.0 | 300 | 11.3 | 1,632 | 7.0 |
| " Churn | 176 | .9 | 11 | .9 | 20 | .8 | 208 | .9 |
| " Incubator | 199 | 1.0 | 8 | .7 | 21 | .8 | 230 | 1.0 |
| " Brooder | 136 | .7 | 1 | ..... | 13 | .5 | 151 | .6 |
| " Hot Beds | 21 | .1 | ..... | ..... | 2 | ..... | 24 | .1 |
| " W. Heaters (F.R.) | 28 | .1 | ..... | ..... | 3 | .1 | 31 | .1 |
| " " " (Met.) | 10 | ..... | 2 | ..... | 3 | .1 | 15 | .06 |
| " Misc. | 313 | 1.6 | 22 | 1.8 | 10 | .4 | 349 | 1.5 |
| **In The Home** | | | | | | | | |
| Elec. Range | 4,289 | 22.2 | 72 | 6.0 | 242 | 9.1 | 4,619 | 19.8 |
| " Hot Plate | 4,534 | 23.4 | 193 | 16.1 | 617 | 23.3 | 5,358 | 22.9 |
| " Washer | 12,188 | 63.0 | 529 | 44.2 | 1,385 | 52.3 | 14,188 | 60.7 |
| " Cleaner | 2,883 | 14.9 | 57 | 4.7 | 200 | 7.5 | 3,143 | 13.4 |
| " W. Heaters (F.R.) | 616 | 3.2 | 44 | 3.7 | 19 | .7 | 680 | 2.9 |
| " " " (Met.) | 484 | 2.5 | 9 | .7 | 58 | 2.2 | 552 | 2.4 |
| " Grate | 218 | 1.1 | 9 | .7 | 11 | .4 | 238 | 1.0 |
| " Port. Air Heater | 2,347 | 12.1 | 53 | 4.4 | 292 | 11.0 | 2,695 | 11.5 |
| " Refrigerator | 1,658 | 8.6 | 44 | 3.7 | 148 | 5.6 | 1,851 | 7.9 |
| " Hand Iron | 16,325 | 84.4 | 756 | 63.1 | 2,026 | 76.6 | 19,230 | 82.3 |
| " Ironer | 167 | .9 | 14 | 1.2 | 19 | .7 | 201 | .8 |
| " Toaster | 10,802 | 55.9 | 482 | 40.2 | 1,335 | 50.4 | 12,648 | 54.1 |
| " Radio | 12,907 | 66.7 | 638 | 53.3 | 1,618 | 61.1 | 15,271 | 65.4 |
| " Furnace Blower | 354 | 1.8 | 7 | .6 | 33 | 1.2 | 394 | 1.7 |
| " Sanitary System | 3,275 | 16.9 | 127 | 10.6 | 352 | 13.3 | 3,757 | 16.1 |
| " Motor | 39 | .02 | 3 | .2 | ..... | ..... | 369 | 1.6 |
| " Pump | 219 | 1.1 | 3 | .2 | ..... | ..... | 42 | .2 |
| " Misc. | 368 | 1.9 | 1 | ..... | ..... | ..... | 228 | 1.0 |
| Number of Consumers Covered | 19,337 | | 1,197 | | 2,646 | | 23,366 | |

Nipissing and Thunder Bay not shown but included in All Systems summary.

TABLE NO. 5

Comparison of Appliances in Use by Rural and Urban Consumers

| | Hamlet | | Farm | | Urban | |
|---|---|---|---|---|---|---|
| | No. of Appliances | Per Cent. of Saturation | No. of Appliances | Per Cent. of Saturation | No. of Appliances | Per Cent. of Saturation |
| Elec. Range | 2,904 | 10.8 | 4,619 | 19.8 | 122,794 | 26.1 |
| " Hot Plate | 5,361 | 19.9 | 5,358 | 22.9 | 66,282 | 14.1 |
| " Washer | 10,616 | 39.4 | 14,188 | 60.7 | 183,081 | 38.9 |
| " Cleaner | 3,106 | 11.5 | 3,143 | 13.4 | 134,323 | 28.6 |
| " Water Heater (F.R.) | 502 | 1.9 | 680 | 2.9 | 28,994 | 6.2 |
| " " " (Met.) | 425 | 1.6 | 552 | 2.4 | 42,381 | 9.0 |
| " Grate | 202 | .7 | 238 | 1.0 | 32,607 | 6.9 |
| " Port. Heater | 2,112 | 7.8 | 2,695 | 11.5 | 140,505 | 29.9 |
| " Refrigerator | 2,247 | 8.3 | 1,851 | 7.9 | 51,309 | 10.9 |
| " Hand Iron | 18,482 | 68.6 | 19,230 | 82.3 | 439,765 | 93.6 |
| " Ironer | 200 | .7 | 201 | .8 | 6,841 | 1.4 |
| " Toaster | 11,486 | 42.6 | 12,648 | 54.1 | 245,283 | 52.2 |
| " Radio | 15,691 | 58.3 | 15,271 | 65.4 | 285,440 | 60.7 |
| " Furnace Blower | 441 | 1.6 | 394 | 1.7 | 12,986 | 2.7 |
| Number of Consumers Covered | 26,929 | | 23,366 | | 469,933 | |

# *O.M.E.A. Annual Meeting*

## *and*

# *A.M.E.U. Convention*

***will be held at the***

## *Royal York Hotel, Toronto*

***on***

## *January 28 and 29, 1936*

# Welding of Copper and Its Alloys

**By W. D. Walcott, Inspecting Engineer, H.E.P.C. Laboratories.**

THE welding of copper and its various alloys presents difficulties not generally encountered in the welding of ordinary steels in which the percentage of carbon is the most important variable. These difficulties are due chiefly to the complex nature of the different metals entering into the composition of the various alloys.

Copper and its alloys may be grouped as follows:

1. Pure Copper.
2. Brass.
3. Bronze.
4. Copper, zinc, tin alloys.

### Copper

In the copper family there are two varieties:—Electrolytic Copper and De-oxidized Copper.

*Electrolytic copper* contains up to one per cent. of oxygen in the form of oxide of copper. This is an impurity which makes the welding of copper somewhat more difficult and even though the texture of a weld is sound, in some instances its strength is decreased as much as fifty per cent.

*De-oxidized copper* is free from oxide of copper and on this account is much easier to weld. The de-oxidizing is achieved by the use of phosphorus, silicon, zinc or cadmium during the process of manufacture. These reagents absorb the oxygen and float it off in the form of slag.

### Brass

The brass alloys contain from 60 to 90 per cent. of copper and from 10 to 40 per cent. of zinc depending on the purpose for which they are to be used. Their melting points range from about 1,600 deg. to 1,900 deg. fahr. On account of the comparatively low melting point of zinc, brasses with a zinc content of 30 per cent. and over are extremely difficult to weld as the zinc is partially volatilized during the welding process and a porous weld is the result. Brasses with a zinc content of 30 per cent. or over are most successfully welded with the oxy-acetylene torch and a Tobin Bronze filler rod, the composition of which is approximately the same as that of the brass to be welded. Brass with a zinc content of less than 30 per cent. may be welded with the carbon arc process and one of the following rods: Everdur, silicon copper or phosphor bronze. Of these, Everdur appears to be the easiest to weld and gives the best results.

Brass with a zinc content of 5 per cent. or lower, may be welded by the metallic arc process, but so far the results obtained have not been as satisfactory as those obtained by using the acetylene gas or the carbon arc process.

### Bronze

The alloys commonly known as bronzes consist of copper and tin. Their composition is from 70 to 95 per cent. of copper and from 5 to 30 per cent. of tin. The melting point of these alloys ranges from 1,800 deg. to 1,950 deg. fahr., the lower tempera-

*Oxide free copper.*

*Ordinary copper.*

ture being for alloys of the higher tin content. As is the case with brass, they can be readily welded by the oxy-acetylene method. They can also be welded by the carbon arc and the metallic arc, and with the same electrodes, namely: Everdur, silicon copper or phosphor bronze.

### Copper, Tin, Zinc Alloys

The composition of these alloys is from 88 per cent. copper, 10 per cent. tin, 2 per cent. zinc, to 60 per cent. copper, 10 per cent. tin, 29 per cent. zinc, with a melting point from about 1,625 deg., to about 1,850 deg. fahr.

They have very similar welding characteristics to the bronzes. Although the tin has such an extremely low melting point, its volatilization point is so high that it gives little trouble on this account. The metal melts and flows freely and quietly. Up to 30 per cent., the greater the tin content the freer flowing will be the bronze. If the tin content is above 10 per cent., however, the metal is too brittle for general use.

The best results in welding these alloys have been obtained with the oxy-acetylene process. Good results have been obtained with the carbon arc and fairly good results with the metallic arc where the zinc content is low. The zinc content is again the controlling feature and as a general rule alloys high in zinc should be welded by the oxy-acetylene process or the carbon arc.

### Details of Welding

In welding copper and its alloys there are three processes which can be used:

1. The oxy-acetylene method.
2. The carbon arc.
3. The metallic arc.

The technique of each of these methods will now be considered in detail.

*1. Welding With the Acetylene Torch.*

In welding copper with the acetylene torch, the following rods have given good satisfaction: Tobin Bronze, Manganese Bronze, and brazing solders. The melting point of rods of this composition is in the neighbourhood of 1,650 deg. fahr., which is somewhat lower than the melting point of copper which melts at about 2,000 deg. fahr.

The surfaces to be welded should be carefully prepared. All foreign matter or scale should be removed by chipping or machining and then the surfaces should be sand blasted if possible. In the case of longitudinal plates which are to be welded together, they should be bevelled to make a V groove of from 60 deg. to 90 deg. The work should then be set up so that the weld can be made in a horizontal position. On account of the high conductivity of copper, the parent metal should be preheated to a cherry red before welding commences. A flux consisting of 90 per cent. borax and 10 per cent. sodium fluoride will assist in getting the material to flow smoothly. A neutral flame should be used. The inner cone should be applied directly to the weld areas, and a small portion should be heated to a cherry red colour. The flame should then be withdrawn sufficiently to allow the fluxed end of the rod to be advanced and melted by the outer envelope of the flame.

The inner cone should never be allowed to come in contact with the metal already deposited, nor should it be allowed to fuse to the welding rod.

*2. Welding With the Metallic Arc.*

The following rods have given good results: Everdur, silicon copper and phosphor bronze.

*Preparation:* The surfaces to be welded should be thoroughly cleaned and all oxide scale or foreign matter should be removed. Where necessary the material should be bevelled to a 60 to 90 deg. V groove.

*Current:*

| Thickness of Parent Metal | Diameter of Rod, Inches | Current Amperes |
|---|---|---|
| Up to ¼ in. . . | 1/8 | 90 to 140 |
| ¼ to ½ in. . . | 5/32 | 190 to 210 |
| Over ½ in. . . | 3/16 | 190 to 240 |

*Polarity*: Reversed polarity should be used.

*Arc:* The arc should be maintained at a length of about one inch.

*Technique:* In starting the weld. the electrode will heat up much faster than the weld due to reversed polarity so that some metal will be deposited before the parent metal is sufficiently heated to obtain good fusion. The starting point of the weld should therefore be preheated so that the welding operation can be started while the parent metal is still hot. Should it be necessary to stop welding in order to change electrodes there will be poor fusion if the weld is resumed at the point where the stop is made. To overcome this condition it is advisable to resume welding about ½ inch back of the crater so that when the crater is again reached the metal at that point will be sufficiently heated to permit the deposited metal to penetrate into the parent metal. Where possible it is advisable to make the weld in one pass. When the weld cannot be made in one pass the beads should be laid not more than ¼ of an inch thick at each pass. The weld metal should be well peened while hot before the next pass is laid. The completed weld should then be lightly annealed with an acetylene torch after the final pass has been laid. In all cases the heat should be confined to the area of the weld.

A flux consisting of 90 per cent. borax and 10 per cent. sodium fluoride will give a smooth, even flow if applied before welding.

*3. Welding by the Carbon Arc Process.*

*Preparation:* The surface to be welded should be thoroughly cleaned and all oxide scale or foreign matter should be removed by chipping if necessary, and by sand blasting where possible.

*Current:*

| Carbon Diameter | Amperes |
|---|---|
| 3/16 in. . . . . . . . | 75 |
| 1/4 " . . . . . . . . | 100 |
| 3/8 " . . . . . . . . | 200 |
| 1/2 " . . . . . . . . | 300 |
| 3/4 " . . . . . . . . | 400 |
| 1 " . . . . . . . . | 600 |

*Arc:* Best results have been obtained by welding with an arc of about ¾ of an inch to 1 inch long.

*Technique:* The filler rod is held almost parallel with the seam with the end that is being melted down kept at a distance of about ¼ of an inch away from the work. The

carbon arc is held at right angles to the seam and is inclined slightly away from the melting end of the filler rod. The filler rod is held in a fixed position and is melted down into the seam by playing the long arc flame directly on the filler rod, not on the parent metal. Sufficient heat thus reaches the parent metal to cause fusion without burning it, thus ensuring maximum strength and ductibility. The smoothness of flow will be improved by using a flux consisting of 90 per cent. borax and 10 per cent. sodium fluoride.

*Precautions During Welding.*

In welding copper and copper alloys, precautions should be taken to protect the welder from the fumes given off during welding. These fumes contain zinc oxide and when inhaled are harmful to the lungs. Where it is possible welding should be done in large well ventilated rooms. The use of fans has been found helpful in carrying off the fumes, and in bringing in a supply of fresh air.

## Permanence of Written Signatures

Recently a letter was received at the Bureau concerning the fading of signatures on important documents. In its printed publications and in replies to individual inquiries the Bureau has many times referred to the bad practice of using a blotter to dry signatures on documents which should remain legible for many years.

On important state papers, commissions, and legal documents a blotter should never be used. Its employment in a busy office can be excused, particularly as most correspondence is only of temporary value, but it should always be remembered that to remove the greater part of the ink instead of letting it soak into the paper and dry there, shortens the life of the writing. This is entirely apart from the quality of the paper, which, in ordinary correspondence, may not be good enough to justify much worry as to the permanence of the ink signature. In the case of important documents, it is, of course, understood that a high-grade permanent paper will be used.—*Technical News Bulletin.*

# Electric Light on the Poultry Farm

POULTRY farming has to-day become one of the most highly specialised departments of agriculture. It is, therefore, not surprising that many who enter the industry with little or no practical experience quickly learn that poultry farming means much more than throwing the food down to the birds and later going round to collect the eggs. In fact, many have learned to their cost that success only comes to those who adopt the most efficient methods available.

The two most important considerations for the egg producer are—(1) to obtain as high a yield as possible from the birds; (2) to obtain as much of this yield during the late summer and winter months, when eggs bring in their highest prices.

The problem of yield depends upon the care taken in breeding, together with proper feeding and management. The period during which eggs are produced, however, can be influenced very definitely by the use of electric light in the poultry house.

A study of egg marketing factors shows clearly that to obtain the highest possible returns from egg farming, it is essential to obtain as many eggs as possible during November and December. If a graph were prepared of the eggs marketed in this country it would be found that the maximum output occurs during March and April with the minimum during November and December. A price chart on the other hand shows that the reverse process occurs, i.e., the highest prices are obtained in November, and the lowest in April. With these facts in mind, let us compare the output of two pens of 95 early hatched pullets, each pen kept under exactly the same conditions, except that the laying house of Pen A was fitted with electric light, which was switched on at 5 in the morning, switched off at daybreak, switched on again at dusk, and switched off at 7 p.m. The following table shows the egg production of both pens:—

TABLE I

| | Pen A With Lights | Pen B Without Lights |
|---|---|---|
| September | 1,672 | 1,605 |
| October | 1,852 | 1,235 |
| November | 1,938 | 902 |
| December | 1,824 | 807 |
| January | 1,491 | 418 |
| February | 1,045 | 1,079 |
| March | 560 | 1,833 |
| April | 1,377 | 1,900 |
| May | 1,900 | 1,805 |
| June | 1,714 | 1,738 |
| July | 1,700 | 1,729 |
| August | 1,482 | 1,510 |
| | 18,555 | 16,561 |

It will be seen from this table that not only was the egg output of Pen A increased, but what was much more important, the heaviest production was obtained during the period of high prices, and the lowest during the

time of minimum prices. In Pen B on the other hand, maximum production was obtained during the month of April when prices were at their lowest. For the purpose of comparing the actual increase in the returns from the electrically lighted pen, it is necessary to examine the output in relation to the wholesale price ruling at the time. The following table shows the financial results obtained from both pens:—

Certain items must, of course, be deducted from this profit, the chief among which are the additional cost of food and the cost of the electricity consumed. The extra food amounts approximately to 4d. per bird for the whole period, while the cost of lighting works out at 2d. per bird. The total extra cost is therefore 6d. per bird, or £2 7s. 6d. for the 95 birds in the pen, which leaves a net balance in favour of the lighted pen of £20.

TABLE II

| Month | Wholesale Price of Eggs in Pence | Value of Eggs from Lighted Pens | | | Value of Eggs from Unlighted Pens | | |
|---|---|---|---|---|---|---|---|
| | | £ | s. | d. | £ | s. | d. |
| September | 19 | 11 | 0 | 7 | 10 | 11 | 7 |
| October | 22 | 14 | 3 | 0 | 9 | 8 | 10 |
| November | 26 | 17 | 10 | 0 | 8 | 2 | 10 |
| December | 23 | 14 | 11 | 4 | 6 | 9 | 11 |
| January | 18 | 9 | 6 | 4 | 2 | 12 | 2 |
| February | 15 | 5 | 8 | 10 | 5 | 12 | 5 |
| March | 11 | 2 | 2 | 10 | 7 | 0 | 1 |
| April | 10 | 4 | 15 | 8 | 6 | 12 | 0 |
| May | 11 | 7 | 5 | 2 | 6 | 17 | 11 |
| June | 12 | 7 | 2 | 10 | 7 | 4 | 10 |
| July | 14 | 8 | 5 | 2 | 8 | 8 | 1 |
| August | 17 | 8 | 15 | 0 | 8 | 18 | 1 |
| | .. | £110 | 6 | 9 | £87 | 18 | 9 |

Table I shows that the production in the lighted pen exceeded that in the unlighted pen by 166 dozen, while Table II shows that the monetary value of the eggs obtained from Pen A was £22 8s. in excess of the returns from Pen B.

It is not difficult to realise that a difference of £20 in a year with 95 birds may well make all the difference between success and failure on a poultry farm running, say, 2,000 laying birds.

A further point of interest in con-

nection with the artificial lighting of poultry houses is that not only does the light result in a higher output of eggs in the autumn and winter, but also that the birds are maintained in a better physical condition and body weight, which is responsible for the slight increase in the egg production.

As has already been pointed out in previous articles in *Rural Electrification,* one of the most important considerations in equipping a poultry house with electric light is to see that the lights are so arranged and are of sufficient intensity to secure a good degree of brightness, and also that some method of control is available for automatically turning on and switching off the lights. Many methods of lighting have been tried from time to time, not only in this country, but also in the United States and Canada. In some cases the lights are switched on at 9 o'clock each evening and put out at 10 p.m. In others the lights are switched on at 4 a.m. and remain on till dawn. The most satisfactory method, however, is that where lights are applied both morning and evening. Certainly the best results under test have been obtained with this method, and it is one of the most convenient to apply.

The special points to be noted in the care and management of birds in electrically lighted houses are as follows:—

The birds should be graded and housed according to age, development and condition. Well bred early pullets in good body weight should be given a high protein mash and a day of about 13 hours. Under these conditions they should give a production of about 60 to 70 eggs per day from 100 birds. Matured pullets of medium production and good body weight will give a production of 50 eggs per day per 100 birds without harmful effect if given a day of from 13 to 14 hours.

Late matured pullets or those of low body weight, should be fed on heavy grain rather than on high protein mashes, and only given a 12-hour day until matured and up to body weight. Old hens that have to be forced and later disposed of should be given a 13- to 14-hour day in the early autumn to keep them in production.

It was at one time thought that extending the day of breeding birds had an adverse effect on them, but this is not really the case. The procedure to be followed with breeders is to throw them out of production to enable them to rest before the breeding season, and then, by the use of lights in January and February, obtain an increased number of early hatching eggs. The hatchability of eggs thus obtained will not be impaired in any way.

From the foregoing it will be noted that lighting alone does not provide a royal road to success, but in conjunction with good breeding, feeding, housing and management, which cannot be separated from one another, the expense and trouble incurred is more than justified.—*Rural Electrification.*

NOTE: Hydro electric power is being used freely for all purposes on chicken farms in Ontario, and its value for increasing egg production is well known, but so far no tabulated comparative records of results such as above have been made available.—Editor.

## J. L. Stonehouse, Forest, Honoured

John L. Stonehouse of the Forest Public Utilities Commission has just completed twenty years of service on that Commission, as Chairman. As a tribute of the service which he has given, the other members of the Forest Commission presented him with a floor lamp at a dinner to which members of group number ten of the Western District Municipal Electric Association were invited, on the evening of Thursday, November 14th.

It was in 1915 that the Town of Forest, in looking forward to the time when it would receive Hydro power, purchased the privately-owned plant and distribution system, and placed the same under the control of a newly formed Public Utilities Commission of which Mr. Stonehouse was made Chairman. The Public Utilities Commission bought new twenty-five cycle steam generating equipment and rebuilt the distributing system, so as to be ready to change over to Hydro with the least possible expense whenever that change was to be made. The change to Hydro came early in 1917.

On February 7, 1917, the Forest System was first served by Hydro, when the town took an initial load of 56 horsepower and supplied 370 consumers. The average monthly consumption of domestic users in 1918 was 9 kilowatt-hours, and the average monthly bill, Ninety Cents (90c.). In that year commercial lighting consumers took an average of 13 kilowatt-hours per month. There were eight power users. The records for 1934 show Forest to have had an average load of 317 horsepower, there being a total of 609 consumers. In that year the average monthly consumption of domestic users was 72 kilowatt-hours, costing $1.96 per month. The decrease in rates from ten cents per kilowatt-hour in 1918 to less than two and three-quarter cents in 1934 was due principally to the people of Forest using the power, and thus obtaining much lower rates. Commercial lighting users took an average of 104 kilowatt-hours per month in 1934, and there were 22 power users. Forest has a population of approximately 1,500.

The meeting was attended by former Mayors and members of the Commission who have held office during Mr. Stonehouse's twenty years of Chairmanship. The presentation was made by Robert Hair, Secretary and Commissioner. Robert Bailey, who was Mayor when the Commission was formed, gave a short address. The present Mayor, W. A. Dunlop, was Chairman.

# A. M. E. U.
## Nominations for 1936 Officers

The scrutineers' report of the primary ballot of the Association of Municipal Electrical Utilities shows the following nominated for candidates for officers for the year 1936. Those names marked with an asterisk (*) will be placed on the election ballot, provided the nominees are agreeable.

President—C. A. Walters*, O. M. Perry*, J. E. B. Phelps, R. S. Reynolds, D. B. McColl and E. V. Buchanan.

Vice-President — H. F. Shearer*, A. B. Manson*, D. B. McColl, R. S. Reynolds, C. E. Brown, V. A. McKillop, C. A. Walters, A. L. Farquharson, W. E. Reesor, G. E. Chase, E. V. Buchanan, W. H. Childs, J. W. Peart, J. E. Skidmore, A. M. Bowman, R. E. Garrett, Geo. Grosz and O. H. Scott.

Secretary—S. R. A. Clement* and W. B. Munroe.

Treasurer—D. J. McAuley*, W. B. Munroe*, H. T. Macdonald, B. Faichney, R. P. Darrell and G. E. Chase.

Directors (from the membership at large)—O. H. Scott*, E. V. Buchanan*, W. H. Childs*, J. E. B. Phelps*, G. E. Chase*, H. F. Shearer, R. J. Smith*, O. M. Perry, P. B. Yates, R. S. Reynolds, T. R. C. Flint, D. B. McColl, V. S. McIntyre, V. A. McKillop, A. L. Farquharson, A. B. Manson, R. L. Dobbin, C. E. Brown, W. R. Catton, C. C. Folger, J. D. Grant, W. J. Jackson, O. C. Thal, H. R. Hatcher, J. J. Heeg, R. Harrison, J. W. Peart, R. M. Parkinson, H. L. Pringle, Robt. Bieth, R. S. King, M. E. Jardine, R. B. Hanna, W. E. Reesor, M. W. Rogers, W. B. Reynolds, R. O. Stalker, Robt. Scott, J. O. Slack, C. A. Waterous.

District Directors:

Niagara District—R. S. Reynolds*, W. H. Childs, A. B. Manson, H. G. Hall*, W. R. Catton,* D. B. McColl, J. E. Teckoe, W. E. Wallace, J. W. Peart, H. R. Hatcher, H. F. Shearer, V. S. McIntyre, O. M. Perry, C. E. Kirkby, A. M. Bowman, J. E. B. Phelps, J. B. Draper, E. V. Buchanan, A. E. Rumble and James Kirby.

Georgian Bay District — C. E. Brown* and R. S. King*.

Central District — G. E. Chase, C. C. Folger*, R. O. Quick*, G. F. Shreve*, Wm. Tait and F. Smith.

Eastern District—A. L. Farquharson* and Jas. D. Grant*.

Northern District—C. J. Moors* and F. Greenslade*.

The election ballots will be distributed on the first day of the winter convention of the Association, which will be held at the Royal York Hotel, Toronto, on January 28 and 29, 1936. The ballot box will be closed immediately after the opening of the afternoon session on the first day, Tuesday, January 28, and the results of the election will be announced before that session closes.

# THE BULLETIN

Published by
HYDRO-ELECTRIC POWER COMMISSION
of Ontario

620 University Ave.
Toronto

Subscription Price $2.00
Per Year


## Hydro Lighting School

A SCHOOL of Instruction was conducted by the Hydro-Electric Power Commission during the week of November 12th for representatives from Hydro municipalities where these municipalities desired to inaugurate a Better Light—Better Sight Campaign. A carefully planned programme was prepared for the purpose, incorporating instructions on the rudiments and the principles of lighting and their application to the improvement of lighting in the home. All available sources of information were tapped and talent for instructions was secured from the best sources available.

A typical living room was set up in the Commission's Head Office building in Toronto and equipped with all of the equipment necessary to make the so-called school complete, and thanks are due to manufacturers of sight meters, projecting machines, moving picture films, fixtures and lamps for their co-operation in supplying the Commission with equipment to help make this school a success. We are also indebted to the equipment manufacturers for the part which their representatives played in supplying material for lectures and assisting in giving instructions to the students.

Quite a number of instruments had to be constructed specially in our laboratory to demonstrate some of the principles involved. The instructions included lectures on many phases of the problems involved in Home Lighting, demonstrations of the principles of lighting and their application, skits showing how lighting is sold and prescribed and talking pictures showing the need for better illumination in the home and elsewhere.

PROGRAMME
OF
LECTURES AND DEMONSTRATIONS
HYDRO LIGHTING SCHOOL

November 12th to 15th, 1935

First Day—Tuesday, Nov. 12.

9.00 a.m.
Enrolment of Students.
Lecture—"The Job Before Us."
Film—"The Science of Seeing."
Lecture—"The Science of Seeing in the Home."

## CONTENTS

**Vol. XXII No. 12**

**DECEMBER, 1935**



*The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.*

Demonstration—"Analyzing the Present Day Living Room."
Discussion.
1.30 p.m.
Lecture and Demonstration—"Fundamentals and The Language of Lighting."
Lecture—"Sight Meters."
Lecture—"Electric Light Bulbs."
Lecture — "Exploded Ideas about Light and Seeing."
Discussion.
8.00 p.m.
Lecture—"How Light Affects the Eyes."
Second Day—Wednesday, Nov. 13th.
9.00 a.m.
Lecture—"Lighting Principles."
Lecture—"Lighting Equipment for the Home"—Fixtures and Portables.
Lecture—"I.E.S. Lamps."
Demonstration—"Placement of Lamps."
Discussion.
1.30 p.m
Demonstration—"The Home Demonstration Kit."
Skit—"A Typical Home Call."
Lecture—"Making Lighting Recommendations."
Lecture—"Hydro Advertising Plans."
Discussion.
Third Day—Thursday, Nov. 14th.
9.00 a.m.
Demonstration — "Problems in Arrangement of Lamps."
Slides—"Modern Lighting Equipment and Modernizing Old Fixtures."
Lecture—"Equipment Required By Home Lighting Advisor."
Discussion.
1.30 p.m.
Lecture—"Buying Motives."
Lecture and Skits — "Selling Approaches."
Demonstration — "Practising Home Visits."
Discussion.
Fourth Day—Friday, Nov. 15th.
9.00 a.m.
Lecture—"Leads and How to Obtain Them."
Lecture—"Keeping Records."
Lecture—"Scheduling Your Time."
Discussion.
1.30 p.m.
Lecture—"Selling the Lighting Idea."
Lecture — "Examination Based on Lectures and Demonstrations."
Film—"Light for Living."
Talk — "Summing Up the Week's Work."
Discussion.

* * * *

Copies of all of the lectures were distributed in printed form to all of

the students who attended; these are available for future reference. Copies of these lectures are available for municipal representatives or others interested in the subject of Lighting and they can be had upon application.

ATTENDANCE AT THE SCHOOL

A total of 39 students attended this Hydro Lighting School made up of 29 representatives from 19 Hydro municipalities, 5 representatives from Department Stores, 3 representatives from the H.E.P.C. and 2 unattached.

The following municipalities had students attending the School:

| | |
|---|---|
| Brockville, | Galt, |
| Kingston, | Stratford, |
| Belleville, | Woodstock, |
| Peterboro, | Welland, |
| Oshawa, | St. Thomas, |
| North Bay, | Chatham, |
| Toronto, | Sarnia, |
| Hamilton, | Windsor, |
| Kitchener, | Wallaceburg, |

Owen Sound.

In each of these municipalities a Lighting Campaign is in progress.

It is felt that the students who attended this school have sufficient information and training to enable them to commence in a small way a local lighting activity, and each was exhorted to put into practice the instructions which he or she received at the school sufficiently to be able to size up the local situation and help in planning a local lighting campaign. All students were advised that the staff of the Hydro-Electric Power Commission is at their disposal to give assistance whenever required in planning local activities, in making Home Lighting calls and demonstrations, in addressing local clubs and societies and giving whatever other assistance which may be necessary to put a lighting campaign under way.

It is intended if the demand arises to hold subsequent schools to instruct representatives from other Hydro municipalities who did not have an opportunity to send representatives to our first school, and it is hoped that reports will soon be available from the municipalities where lighting campaigns are in progress to enable other municipalities to decide whether or not a local campaign should be sponsored in their particular localities.

# *O.M.E.A. & A.M.E.U. Convention*

## *at*

## *Royal York Hotel, Toronto*

## *January 28 and 29, 1936*

# I. E. S. Certified Lamps

**By Wm. F. Little and R. B. Brown, Jr.**

(*Presented to Illuminating Engineering Society Convention at Cincinatti, Ohio, Sept. 3 to 6, 1935.*)

THE certified lamp idea was not born either as an advertising stunt or a sales programme. It was actually the result of conditions found in one of the large American colleges where the dormitory study room lighting was uniformly and notoriously bad. In this university the wattage consumption was limited to forty watts per person (two in a room). The units were inefficient, ineffective, glaring and poorly located. These conditions prompted the design of a wholly new lamp, a lamp in which the governing factors were limited wattage (average not more than one hundred watts per room), wide spread of light sufficient for two students, adequate amount of light downward for study and reading purposes, and general illumination throughout the room sufficient to relieve excessive brightness contrasts.

With these conditions to meet it was at once apparent that any lighting equipment having not more than one hundred watts capacity must be highly efficient and free from glare, either direct or reflected. The lamp must be tall, must be equipped with a good reflector which transmits a fair amount of the light and a shade which shields from view most of the reflector.

The high lamp provides not only a wide spread of illumination but a more favourable angle of incident light on the horizontal surface. This is very important in the shortening of shadows, lessening of reflected glare and reduction in brightness of the source.

The glass reflector should have a reflection factor in the neighbourhood of 0.65 with a sufficient area and transmission such that with the lamp filament placed 2⅞ inches from the top, the brightness up to 60 deg. will not exceed 3.0 candles per square inch.

The shade should be so proportioned and of such material that it will shade the bright area of the reflector from the line of view under normal conditions. Its inner surface must be of sufficiently high reflecting value so that the light upon the desk top will be increased by its use rather than decreased as is usual. This requires a material having a high reflection factor which is substantially opaque. These requirements can readily be met by the use of heavy paper or fiber. If fabric is employed it must be heavy, closely woven and extremely white. Preferably the reflector and shade should meet at the top, thus providing a large continuous area of relatively low brightness. The placing of the shade upon a study lamp results in a very small decrease in light output, as a rule not more than three or four per cent.

To meet these requirements the highest shaft obtainable was secured, the glass manufacturers' stock of re-

flectors was drawn upon and heavy-white paper shades of all shapes and sizes were tried out. The result was a lamp which more or less resembled the present I.E.S. study and reading lamp. This story, and the lamp, were presented to the Committee on Industrial and School Lighting of the Illuminating Engineering Society, with the result that an investigation of dormitory study room lighting in the colleges and universities throughout the United States was started and a further study and development of the lamp was requested. Five hundred rooms in sixteen colleges were surveyed. The lighting condition in these rooms was very poor. In general, the conditions found were high intensities on the work, extremely low intensities adjacent thereto and little or no general illumination in the room. The results of this investigation were reported at the last Convention.

### Study and Reading Lamp

It was difficult to find a lamp manufacturer with sufficient vision and willingness to co-operate to make the first models. However, he was found, lamps were made and the lamp became widely discussed and promoted as a study and reading lamp having even greater application in homes than in college dormitories. Modifications of the lamp were suggested and specifications drawn to completely cover the equipment. During the first twelve months these specifications were twice revised; the last revision includes a study lamp with a 50/100/150-watt three-light bulb. Before the completion of this last revision a study lamp appeared on the market utilizing this three-light lamp. The lamp, however, could not meet the specification requirements because either the brightness was too great with the 150-watt filament or the illumination insufficient with the 100-watt filament. This necessitated the design and manufacture of a wholly new reflector of an intermediate size, 9⅜ inches in diameter, having an area sufficiently large to meet the requirements. This reflector was designed under the auspices of the Illuminating Glassware Guild and at the present time seven manufacturers are making the reflector to specifications issued by the Guild.

### Indirect and Semi-Indirect Floor Lamps

The specifications covering indirect and semi-indirect floor lamps were developed by an entirely different committee of the I.E.S., working toward a different objective. This committee was specifically charged with the responsibility for creating specifications for the indirect floor lamp. Up to that time indirect floor lamps had many faults, chief of which was notoriously poor efficiency. This resulted in excessive waste of light and the use of high-wattage lamps. The public has been slow in accepting the indirect floor lamp idea although it has been preferred for certain purposes and in these fields has received a small share of its merited popularity.

At this time two new lamps were designed by the incandescent lamp manufacturers. One lamp, a 250-watt filament in a bulb of special size and shape, but having a medium-screw base, was made exclusively for service

in indirect lamps; it is known commercially as the indirect-light lamp. The other lamp is a two-filament type giving three degrees of light. It has a mogul base and gives the equivalent of 100, 200 and 300 watts by the turn of the switch.

Based on the new bulbs, the committee prepared specifications for two types of floor lamps, indirect and semi-indirect, which would insure efficient and satisfactory performance, consistent with the standards already set by the I.E.S. study and reading lamp. The totally-indirect lamp delivers general illumination only and is not intended for study and reading purposes. The semi-indirect lamp, on the other hand, combines the features of totally indirect lamps and the study and reading lamps, and can be used for the same applications. Owing to the larger lamps employed, the physical dimensions of the semi-indirect and indirect lamps must exceed those of the study and reading lamp. These new lamps have at least fifty per cent. more lighting effectiveness than the average lamp which has not benefited by these improvements.

### The Certification Plan

Having completed specifications for three distinct types of portable lamps, the next step was to devise a plan which would put them into service. The I.E.S., being a professional organization, was not interested in entering the portable lamp business. Hence, there has been no incentive and no consideration given to securing commercial advantage, either for the Society as a whole, or for its individual and company members. It was, therefore, decreed that the specifications would become generally available and the right to make the lamps accorded to all who agreed to build them in accordance with the requirements.

To create a demand for I.E.S. lamps, a certification plan was drawn. Under this plan, the I.E.S. authorized the Electrical Testing Laboratories of New York and later, the Hydro-Electric Power Commission of Ontario to issue tags certifying compliance with the I.E.S. specifications. Lamps so tagged became marketable merchandise, and the manufacturers were at once provided with the necessary incentive to make them available in large quantities. Having supplied the incentive to initiate this activity, the Society is transferring to the lamp manufacturers the responsibility of carrying on this progressive, profitable and important development. The Society retains a Committee on Portable Lamp Specifications to co-operate in the further development of these lamps. In the main, however, the pioneer work has been done, the acceptance by manufacturers and consumers of high-grade, intelligently-engineered floor and table lamps is an accomplished fact.

### Performance Requirements of the Specifications

The specifications for the three types of portable lamps consist of requirements, compliance with which is expected to assure lighting equipment that, when properly installed under the conditions for which it is intended, will render good service by providing convenient and effective illumination with conservation of eye-

sight. Further, that it will render this service over a reasonable period of time with a minimum of casualty and fire hazards. The requirements come under three broad classifications: first, effectiveness requirements; second, safety requirements; and third, construction requirements. Thus, it is readily apparent that the lamp must not only be good from the standpoint of supplying adequate and proper light without glare, but it must also be durable and safe.

It is proper to state that no portable lamp was ever required to pass a more rigid set of specifications, and that quite apart from illumination characteristics, the specifications have the effect of improving the mechanical and electrical construction well above that commonly employed heretofore. Each part of the specification, therefore, contains features which show the outstanding quality of these lamps as compared with any others on the market.

### Effectiveness

The first important characteristic of these lamps is effectiveness. In drawing up effectiveness requirements the committee kept in mind the need for high efficiency, at least seventy-five per cent. light output (with at least forty-five per cent. above the horizontal for general illumination for the study lamp); freedom from glare by reason of low brightness not to exceed three candles per square inch, relatively uniform illumination on the working area of ten to twenty foot-candles with good illumination over an extended area.

### Safety

For safety the electrical construction requires a high standard of electrical insulation, such that should a person touch the switch of the lamp and at the same time touch a radiator or other well-grounded object, he could not receive an electrical shock even under very humid conditions. The maximum leakage current of 0.2 milliampere was selected, first, because it is the threshold value for physiological sensation and, second, to provide a safety factor to allow for the depreciation of the equipment and the danger to children and other sensitive people. Leakage may result from any one of a number of causes, such as poor insulating material in switch or socket. However, impregnation, lacquer and rubber tape have practically eliminated this fault.

Of the first fifty lamps submitted not five per cent. met the leakage current test requirements as received. Weeks of experimental work and research were necessitated covering hundreds of sockets, switches and attachment caps to clear up all the difficulties. For example, because of the leakage in the brass shell socket interliners, in many cases it was found necessary to require porcelain sockets. Even here some trouble was experienced because of the hydroscopic properties of the sealing compound. During the period of experimentation, a high heat-resisting impregnated interliner was developed for the brass shell socket and a waterproof sealing compound for the porcelain socket which reduced failures to a negligible quantity. The customary use of asbestos-covered fixture wire for switches and in the pipe stems was found unsatisfactory. After many changes and much experimentation

a lacquer-covered wire was specifically developed to meet these needs. The wire and parts manufacturers co-operated very generously in these developments.

The first few lamps submitted were given a temporary certification because the high-quality cord called for in the specifications was nowhere available. In the course of several months, however, at least nine manufacturers were producing either cotton or rubber-covered No. 18 A.w.g. wire with No. 34 A.w.g. stranding. At the present time not only I.E.S. but a large percentage of all portable lamps are equipped with this high-quality wire which incidentally is now supplied at a price equal to or less than that of the poorer quality of wire which was in general use prior to the I.E.S. portable lamp movement.

To insure the desirable insulation qualities on the entire equipment, it is subjected to a proof-voltage test of 900 volts.

### Construction

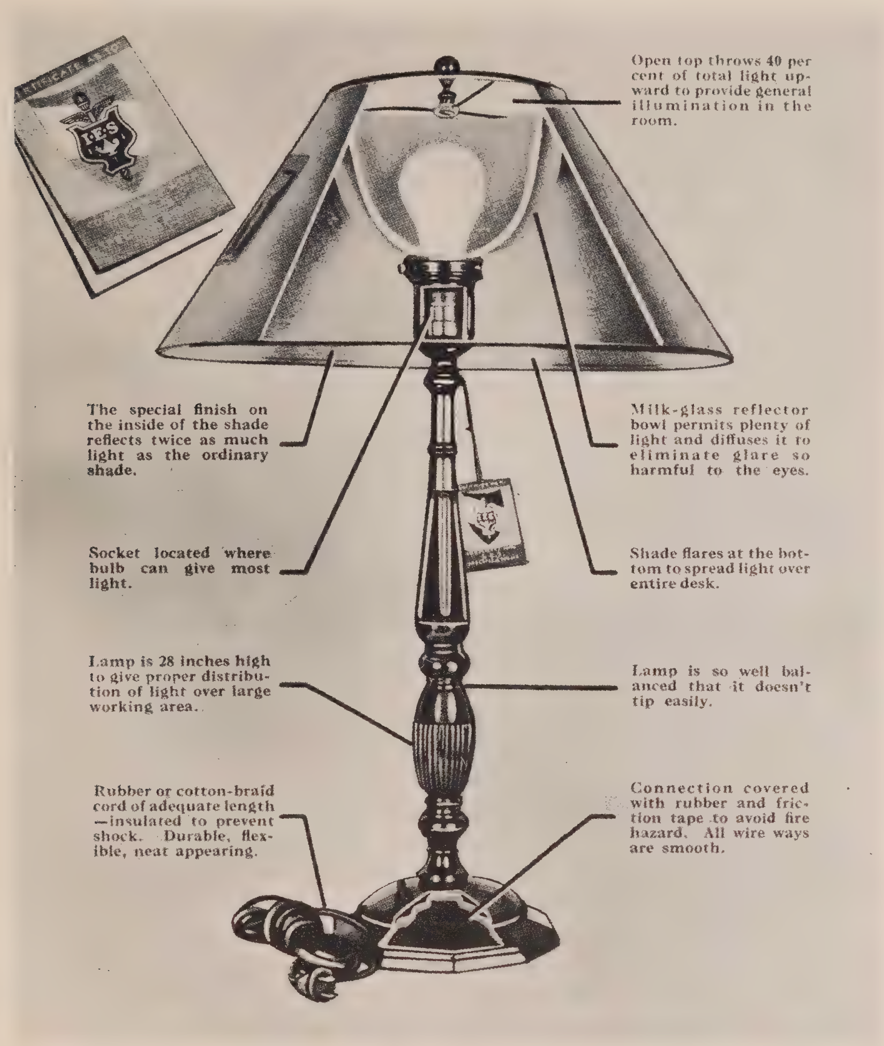
Contrary to general opinion, an underwriter's approval label attached to the wire or some other integral part of the lamp does not insure its safe performance, since it does not eliminate all of the other possible defects which may be present. Contrary to popular opinion, also, portable lamps as such are not subject to inspection and approval by local wiring authorities, hence, there is little opportunity to prevent poor quality lamps being sold. The purchasers of I.E.S. certified lamps, however, are offered protection against this hazard, because samples of the lamps offered for sale must pass numerous tests designed to disclose faulty insulations, poor wiring or other defects referred to above.

The construction requirements are such that the assembled lamp shows reasonable excellence in the electrical and mechanical features of construction in order to assure safety and continuity of service. All wiring connections must be made in accordance with best practice. Smooth wireways and bushings are required and all joints not terminating under screws must be soldered and double taped. The switch must be on the proper side of the circuit and must be capable of opening and closing 12,000 times without failure. The sockets must be well insulated and properly connected to the lamp so that they will not loosen when lamps are screwed in and out. The attached cord must be at least seven feet long and must be either cotton or rubber-covered for durability, have fine strands for flexibility and durability, and must be of an approved type carrying the Underwriters' five-foot label.

The construction requirements even cover the style and type of attachment cap which must be of material not easily broken, preferably of soft rubber compound, or the equivalent, and must have a finger-grip to aid in its easy removal from the receptacle.

The stability of the assembled lamp must be such that it will not tip over when tilted ten degrees from the vertical in any direction in the case of a table-type, or seven degrees in the case of a floor-type lamp.

The specifications further state that the construction of the equipment will be such as to insure durability of the assembly and will be sufficiently




*The I. E. S. Certified Lamp and Tag.*

sturdy to withstand normal service conditions. The finish of the lamp must be such that it will not peel, be easily damaged or soiled during installation or after being placed in service. Further, the complete unit must be readily assembled and installed.

The importance of these safety and construction requirements cannot be overestimated. Lamps which pass the specifications are much more desirable, and what is equally important, these valuable features of electrical and mechanical excellence are obtained at little increase in cost over the inferior products which clutter the market to-day. The fact is that

experience with the I.E.S. Certified Lamp Plan has proved that high-quality portable lamps, as with many other electrical products, can be offered at practically the same prices that the customer has been paying. By selling lamps that are certified according to I.E.S. specifications everyone gains. The public is well served and the lighting industry likewise is repaid for having sold a better product.

### Commercial Aspects

The speed with which the certified lamp idea has been commercialized by the lighting industry has no doubt puzzled the managers of many portable lamp departments. There has even been in evidence some question as to whether or not this is a "racket", devised and engineered by the light and power industry.

The fact is that lamps certified as to compliance with I.E.S. specifications became marketable merchandise having excellent commercial possibilities. The commercial departments of various organizations therefore picked up where the Illuminating Engineering Society left off, in order to place these lamps in the home. Obviously, an engineered product, no matter how good, cannot sell itself. The power of advertising and salesmanship is required to inform the public, to arouse their interest, and to create in them a desire to possess these better products.

Manufacturers of incandescent lamps and the public utilities have joined with manufacturers of portable lamps in the greatest advertising and sales programme the electrical industry has ever brought to bear on home lighting. Further, the Better Light—Better Sight Programme, representing the industrial and professional groups of the lighting industry, has endorsed the I.E.S. Certified Lamp Programme, and their official seal is attached to all lamps which meet the specifications.

### Conclusions

The certified lamp project has been responsible for many improvements in portable lamp quality, some of which are listed in the following table:

1. For the first time good engineering practices which are found in some other types of lighting are incorporated in portable lamps.

2. The efficiency of the average portable lamp has been increased by at least fifty per cent.

3. General illumination with adequate, reasonably uniform light on the work is provided from a large source of low brightness.

4. By improved insulation resistance and decreased electrical leakage far beyond any previous performance, the safety standard has been raised, thus greatly reducing personal hazard.

5. Socket construction and materials going into their manufacture have been improved.

6. A new standard for high quality, durable, flexible cord has been set.

7. The electrical construction of the lamp has been improved by requiring soldered, double-taped joints or approved connectors where previous practice had been to merely twist the wires together.

8. A higher standard has been set for the quality of mechanical construction throughout, eliminating sharp edges in wireways, promoting

generous use of bushings, durable materials and durable finish.

9. A new standard for assembly has been set.

Up to the present time lamps have been certified for fifty-four different manufacturers, the certification service has been withdrawn from and restored to three manufacturers, four manufacturers have discontinued the manufacture of I.E.S. types of lamps and over half a million certification tags have been issued.

# School Lighting

**By Geo. G. Cousins, Engineer in Charge of Illumination, H.E.P.C. of Ont.**

WHY should schools be lighted when they are used during the brightest period of the day, from 9.00 a.m. to 4.00 p.m.? They are liberally supplied with windows and one is inclined to think that nature provides an abundance of light, and that the only need for artificial illumination is a little bit to help out toward the close of exceptionally dark afternoons. This matter is, however, not so simple and is of such great importance that it should receive the most serious consideration of all those responsible for the welfare of children in school.

Statistics show that about 25 per cent. of children in the public schools have defective vision, about 19 per cent. of which is acquired after starting at school and the percentage is increased to 38 per cent. in the colleges. Most of these defects are permanent and remain as serious handicaps, interfering with the play life and school progress of the younger children and with the serious aspects of life when they enter into gainful occupations. It is well known, having been proved by test, that defective vision and inadequate lighting demand greater expenditure of energy in accomplishing tasks and that good lighting overcomes the defects of poor vision to a very large extent and in addition, conserves normal vision. It is evident, therefore, that everything possible should be provided for the welfare of school children to conserve their natural endowments and so avoid sending them out into the serious phase of life with permanent handicaps that could have been avoided or at least mitigated.

A large percentage of rural schools have no artificial lighting, many of those in towns and cities have lighting of a standard at least twenty-five years old, and throughout the country those that approach fair lighting represent an insignificant portion of the total. Very frequently while inspecting lighting in schools, teachers express a fervent hope that something will be done to improve conditions.

## Daylight Conditions

Daylight in school rooms is both an asset and a liability. It is necessary, of course, to have light and it is natural to utilize what nature provides so abundantly. But daylight

is difficult to control because the light source, the sky, is so vast that we cannot direct its light so as to utilize it most effectively. As a result, the children near the windows have plenty of light on bright days and their line of vision to the blackboard is such that they do not see bright reflections on it. On the other hand, the children farthest from the windows receive only about 1/20 of the intensity of illumination that those near the window receive and the former are faced with bright reflections of outdoor objects and sky on the blackboard. There is thus a two-fold handicap imposed upon the children farthest from the windows that impedes their progress. When windows are on two sides of the room the distribution of daylight is better but the reflections on the blackboard are worse.

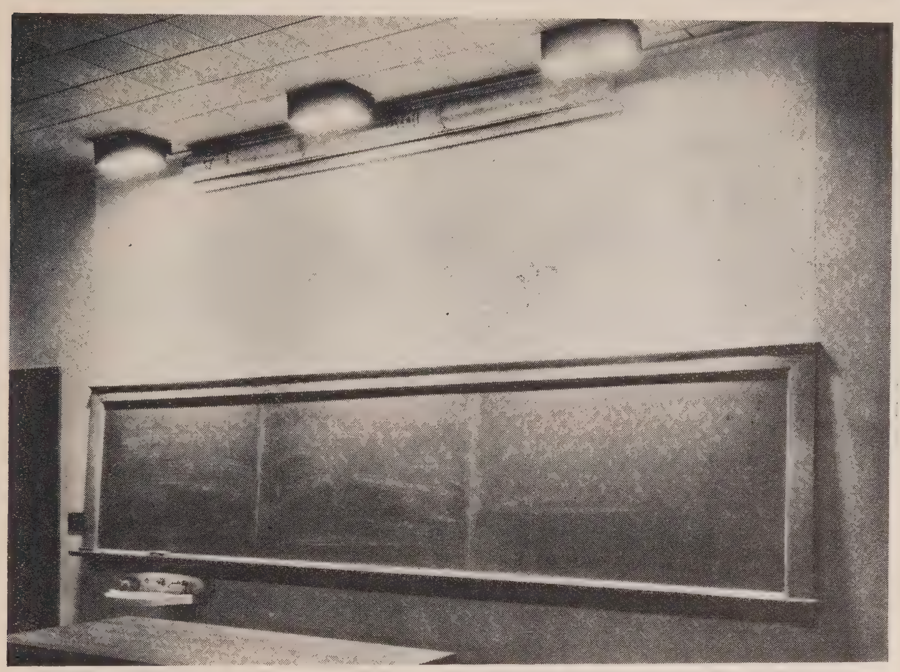
On a bright day the desks farthest from the windows receive only about 5 foot-candles and on a dull day, it may be 1 foot-candle or less. Such lighting is totally unfit for such work as reading and writing. Such conditions produce eye-strain, excessive drain of nervous energy and permanent injury to eyes.

It would be unjust punishment to transfer a pupil from the bright side to the dark side of a room. Why, therefore, should some children innocently have to endure the handicap of the dark side of the room during a school term?

It is practically impossible to make any appreciable improvement in the distribution of daylight in a room. The glare from blackboard reflections may be mitigated to some extent by the proper use of window shades. Each room is an individual problem, some are much worse than others, depending upon outside conditions. The best shades are of the Venetian blind type. White translucent cotton shades are next. In many rooms it is advisable to install two shades on one window with the rollers about midway between the bottom and the top so that one shade may be drawn down and the other up as required. This matter should receive more consideration than it does and teachers should be instructed in the proper use of window shades.

### The Need for Artificial Lighting

A test extending over three years was made to ascertain what portion of the day school season required artificial lighting because the daylight on dull days was insufficient. A room was equipped with automatic lighting control to turn on the lights when the daylight intensity fell below the artificial lighting intensity which was 15 foot-candles, which is considered the lowest intensity that should be used. It was found that the artificial lighting was used for 34 per cent. of the total school hours. This represents about 425 hours per year, or at the rate of 5 hours per day 85 school days, or 17 weeks when the daylight was inadequate. There are many days during the fall and winter when the teachers have to abandon their regular schedule because of insufficient light. This time is practically wasted and must be made up later. Furthermore, it has been proved by carefully conducted tests that there are three times as many failures in poorly lighted rooms (5 foot-candles) as there



*Special Blackboard Lighting.*

are in well lighted rooms (15 foot-candles). Each failure must spend time at the community's expense to go through the class a second time.

It has been estimated that over 80 per cent. of our knowledge is gained through the sense of sight. Therefore, adequate light for seeing is necessary and if, due to dull days, the distance of seats from the windows and other causes, daylight illumination is insufficient, artificial lighting must be provided or the child is the direct loser.

The child under poor lighting must work harder, expend more nervous energy, than one under good lighting to accomplish the same amount of work. Consequently, it is more difficult for such children to keep pace with those more favoured by good lighting. It is more than probable that many cases of backwardness are caused by faulty lighting.

### Lighting Requirements

Briefly stated, the essential requirements of good lighting are adequate intensity of illumination, substantially uniform distribution of illumination and freedom from glare. Intensity is a matter of proper lamp size and appropriate wire size. The average school room is about 30 by 20 ft., and to produce a reasonably good distribution of illumination, 6 lighting units are required. If less than 6 are installed some children will be favoured and others handicapped. Glare may be caused by unsuitable lighting units. Usually indirect or dense bowl semi-indirect units are


*A Sight Saving Classroom.*

less likely to cause glare than direct lighting units unless the latter are selected after a careful study of the room in which they are to be installed. Glossy desk tops are, and direct lighting units are, likely to cause reflected glare.

The special lighting of blackboards is very important in some rooms and not so important in others, depending to a considerable extent upon the type of general lighting installed. Where severe daylight reflections on the blackboard exist, they may be reduced by partially darkening the windows near the blackboard and lighting the board by special artificial lighting units.

School lighting should be planned by a competent engineer as there are important details to be considered that might mar the result if not properly studied.

### The Cost of Lighting

In these days of financial stress, costs must be carefully considered. Ordinarily the cost of school lighting is about one-half of 1 per cent. of the total operating cost and in a great many cases much less, and this is to provide the only agency that can help the sense that contributes over three-quarters of the knowledge.

The high cost of poor lighting is difficult to estimate as it includes some factors that are difficult to express numerically. However, the following factors should be taken into account:

1. The cost of power, lamps and fixtures for lighting.

2. The cost of re-instructing ¾ of the pupils that fail to pass their examinations.

3. The cost of 17 weeks of inefficiently used time on dull days.

4. The cost of medical fees and glasses for eyes injured by bad lighting.

5. The cost of accidents caused by poor lighting in the manual training rooms.

The above items represent dollars and cents. Added to these are:

6. The cost in physical suffering to a child of the headaches and ill health due to a sustained effort to see under adverse conditions.

7. The cost of a year's or part of a year's time due to failure at examination that good lighting might have prevented.

8. The cost to the teacher of nervous strain due to inattention when pupils cannot apply themselves to their work on account of poor lighting.

9. The cost to adults of permanent handicaps of vision impaired in childhood that good lighting might have prevented.

This is a formidable list of costs, all of which are going on year after year and which represent wasted money and physical energy. The first item must be increased slightly to produce good lighting but a large part of the second item and all others could be practically eliminated by the slight increase in the first.

The costs of re-wiring a school, fixtures, lamps, power, etc., are influenced by local conditions but the following figures represent the general order of expenditures necessary for lighting one room with six 500-watt indirect fixtures which will produce good lighting. The installation cost including wiring, fixtures and lamps is about $115.00. Estimating the life of the installation at 10 years (a very conservative estimate) the cost per year (not including interest) is about $11.50 or about $1.00 per month. The cost of power at Hydro rates in Ontario would be about $4.60 per month. The combined cost for good lighting would be about $5.60 per month or $61.44 per year per room. (These figures do not include the cost of night classes).

The use of 300-watt instead of 500-watt lamps would save about $8.00 per year but this small saving would be at the sacrifice of effectiveness in seeing and the benefit to be derived from the 500-watt lamps is well worth the difference in cost.

These figures are based upon the use of the lighting system for 425 hours per year. This does not necessarily apply to every year nor to every district. This estimation is based upon the only actual record for three years of hours of use that has come to our attention. When left to the discretion of teachers its use would be a relatively small portion of this time. A reduction in the hours of use or the wattage of lamps would not reduce the cost of power in the same proportion because the reduced power would not extend into the second and third blocks for which the rates are very much lower. These figures are offered as a general guide only.

Compare this cost of good lighting with the items of cost listed in the foregoing. Think of the benefits of the teacher and the class being independent of weather conditions or the positions of pupils' seats with reference to the windows, of efficiently utilizing those 17 weeks of dull days and the saving by eliminating about three-quarters of failed examinations.

Figure out what proportion $61.44 is of the total annual operating cost per room per year and see if an equal benefit can be obtained for the same expenditure by any of the other items of school expense.

In considering the cost of lighting it must be borne in mind that lighting is the most necessary adjunct to progress in learning and is not a refinement in school equipment.

The cost of one pair of eye-glasses properly fitted will pay for the power for good lighting for one room for about three months, in many cases for more than three months.

### Conclusion

In dealing with the welfare of children in school we cannot overlook the humanitarian side of the matter. It is the duty of parents to provide for the needs of their children and in the same way it is the duty of school boards to provide for the welfare of the children entrusted to their care during school hours. Sight is the most precious sense, both from the viewpoint of the acquirement of knowledge and the enjoyment of life. The eyes of children are easily injured by bad lighting and, unfortunately, these injuries are usually permanent.

Good lighting not only preserves good vision but also results in greater benefit to defective eyes than to normal ones.

It is false economy to attempt to spread a limited appropriation for lighting over a whole school. Each room should be lighted properly so that all the children in it are equally favoured. If the funds are limited, plan to light one or more rooms at a time until they are all properly lighted.

The statements made in this article are the results of actual experience and test. In many cases good lighting has resulted in an actual saving in operating cost.

In the planning of new schools lighting should receive equal consideration to the heating, ventilation and sanitation. Fine furnishings, decorations and all the features that go into a modern school inspire justifiable pride in the minds of people of the community but they do not help the children to see the work or conserve their eyesight for the serious stages of life.

The teachers should be encouraged to pay close attention to the lighting in spite of the fact that they have plenty to do, as the scholars cannot progress properly if they cannot see properly.

Good lighting is a preventive of injured eyes, cure is usually impossible.

# Better Light — Better Sight
## Has Come to Stay in London

**By E. V. Buchanan, General Manager, The Public Utilities Commission, London**

LONDON has entered the Better Lighting field. Believing that in a virgin campaign such as this that publicity and missionary work are essential to propagate the new idea of lighting, the entire month of September was devoted to this work. Beginning with a large spread in the papers the first week, in which the paint dealers, optometrists, electrical dealers and furniture stores co-operated, the preliminary story of Better Lighting was told.

This was followed up with a small booth at the Western Fair during the second week. Here, in little alcoves, the various faults, such as glare, reflected glare, coloured lights and others, were arranged in such a way that the public could play with the switches and find things out for themselves. This installation demonstrated very graphically the troubles caused by poor lighting. The remedy was presented in the form of I.E.S. study and trilite lamps and a revolving display of fixtures that met with the new better lighting standards. The interest shown by the public was intense and fully justified further efforts on our part.

Many people requested that lighting advisors call at their homes to test and readjust the lighting. Incidentally, these advisors had been trained the week previously at a five-day school where home lighting, rates, the new Science of Seeing and other allied subjects were discussed. The lectures were given by various members of the staff and by Miss Eleanor Potts, whose services we were fortunate in securing for three days.

### Well Attended Exhibition

The following week was devoted to further advertising, culminating in a large newspaper spread at the end of the week in which the allied trades joined. The last week of the month was given over to a Better Light—Better Sight Exhibition in a vacant down-town store, pictures of which are shown herewith. The various manufacturers co-operated splendidly in this and there were displays by the Canadian General Electric, Canadian Westinghouse, Northern Electric and Hydro Lamps.

The local optometrists installed and decorated a joint booth and had someone in attendance to answer the many questions that were asked on ocular subjects.

The Scott Paint-Varnish Company, a whosesale and retail store, equipped a booth with panels of different colours and demonstrated reflection factors with the aid of a projection sight meter that was rented from Nela Park. Two living rooms were furnished, practically identically, by Smallman & Ingram, a local department store. One was lighted like the average living room of to-day and the other according to better lighting standards. The marked difference


*London's Better Light—Better Sight Exhibition, held during the last week in September, was particularly well advertised with plenty of light.*


*One of the most outstanding booths was this contrast of "right" and "wrong" in living room lighting. Note the absence of advertising.*

attracted much attention and the accompanying photograph shows it much better than it can be described.

The centre of the exhibition was given over to a display of I.E.S. lamps, exhibited by various electrical and furniture dealers. There were, also, fixtures from local electrical dealers in a revolving display. The back of this display contained the alcoves that were used previously at the Western Fair.

A model office with proper and improper lighting wired to either side of a two-way switch so that observers could switch from one to the other attracted considerable attention.

### Light for Living

The rear of the building was occupied by a little theatre capable of seating about one hundred people. Talking films were shown by courtesy of the various electrical manufacturers and the local optometrists. The programme included "Light for Living" with H. F. Barnes of Nela Park, "Brighter Times Ahead", a short street lighting cartoon and "Just Around the Corner", an appliance picture shown by the Canadian General Electric. Westinghouse supplied "The Home of To-morrow" with Lowell Thomas and the local opticians secured the Better Vision Institute film "The Marvel of Vision" with Floyd Gibbons. The entire programme took a little over two hours and, during most performances, showed to a crowded house.

### Outstanding Success

As the Exhibition was just off the main street, every effort was made to attract attention. Luminous pylons made of wood and cotton with coloured lamps inside were placed at the curb. The sign was of the new silhouette type and stood out wonderfully against the dark background. Briefly, everything was done by all concerned to make the Exhibition as attractive, entertaining and instructive as possible. The results obtained, in our consideration, justified their efforts. Some five thousand people attended and all appeared genuinely interested in the exhibit judging from the multiplicity of questions. Many left their names for advisors to call and countless others indicated their intention to telephone for advice.

Still more must have gone home and made the necessary changes without asking for help, if the number of husbands who returned a second night bringing their wives and telling the story themselves is any indication.

In fact, it will be many months before we will begin to appreciate the far-reaching results of this publicity campaign although, as mentioned previously, present results alone justify the expenditure. London has cast "Its bread upon the waters" and has no hesitation regarding the future. Better Light for Better Sight is here to stay.—*Electrical Appliances and Supplies.*

# Getting Light Into the Classroom

By J. W. Bateman, Manager, Lighting Service Department, Canadian General Electric Company, Limited, Toronto

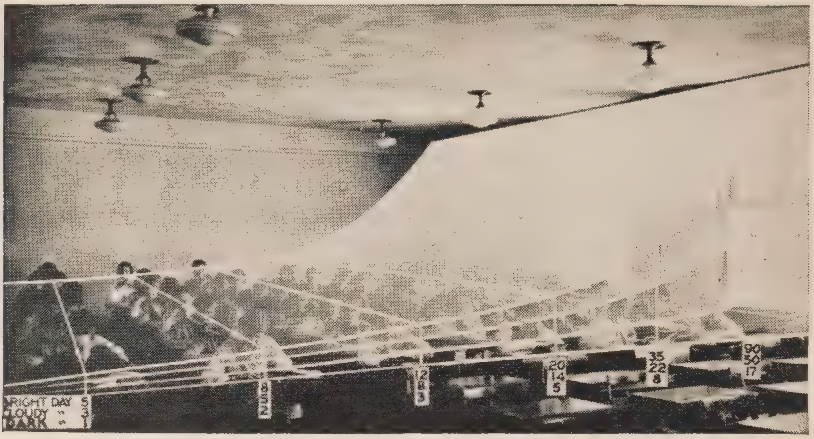
WE have seen how bountiful Nature is in providing light for out-of-door eyes—from playground light to that for serious work. But let us follow Nature's light indoors and try to analyze why daylight indoors, even close to the windows, is so small a fraction of that outdoors.

If you were standing in an open field on a clear sunshiny day, you would have, say, 10,000 foot-candles of illumination falling on you. The sun itself would supply about 8,000 directly and the sky would contribute the rest. Now suppose a cloud passed under the sun and cut off the 8,000 foot-candles coming directly from the sun. There would be, perhaps, 2,000 left, although this might vary widely, depending on the density of the cloud, the general atmospheric conditions, and a number of other factors. This illumination would be diffuse and shadowless, coming from the entire vaulted dome of the sky. Unless the sky was heavily overcast, the brightest part of the sky, and consequently the part contributing most of the light, would be that area immediately surrounding the sun.

Now, if you went indoors to any window where there is no direct sunlight streaming in, you would expect the illumination at the window to be reduced, since the window is exposed to only a small part of the sky's dome. The reduction from 2,000 foot-candles out in the open field, to around 100 at the window is logical, since only a twentieth of the total sky area would normally be exposed to our view if we stood looking out of the window. The actual readings of illumination at the window sill will obviously vary considerably, depending on whether the exposure is north, south, east, or west and in the case of the latter three particularly, with the position of the sun in the sky, according to the time of day and the season of the year. Of the light that comes to the window, 10 to 25 per cent. (depending on the angle of incidental light) may be reflected back by the glass surface and another 10 per cent. absorbed by the glass. If screens are used, about a third may be shut out by the screen. Even a week or so after cleaning, the thin film of moisture and dust that collects on the window can be counted on to cut down the light transmitted to about 75 per cent.

The point is that it is very difficult to get daylight indoors—by the time we get it just inside the window 99 per cent. of it is lost. No wonder, then, that the building codes for schools have given careful attention to scientific window design.

Now that we have our 1 per cent. of outdoor foot-candles indoors, let us examine how this light is distributed about the room; on the desks and books where the children use their eyes and where the light for the first time really goes to work. With windows on one side such as shown, the light falls off rapidly as




*Graphic illustration showing how daylight falls off rapidly in a classroom so that even on a bright day a student away from the window only gets 5 foot-candles.*

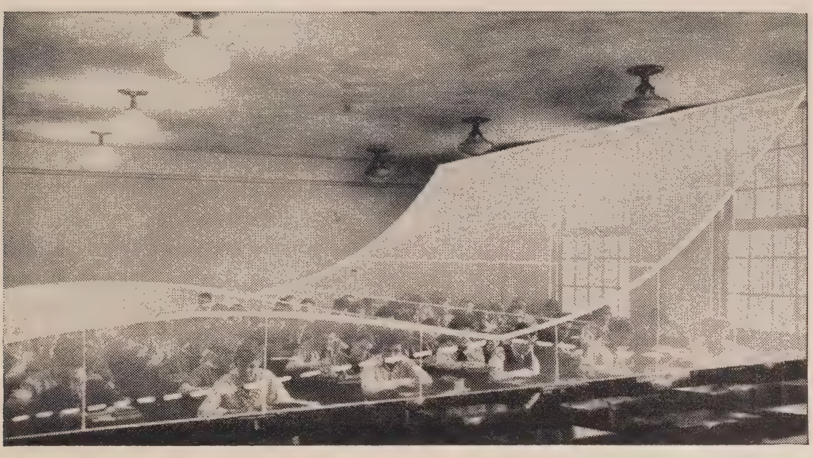
we get away from the window. We have tried to illustrate this by the light block pattern superimposed above the desks—the thickness of the block at any point representing the relative foot-candles on the several rows of seats.

So rapidly does the light fall off from one row of seats to another as we go away from the window that although we lost 99 per cent. of Nature's light getting it into the classroom, another astonishing fact is that we may easily lose 95 per cent. of this remainder getting it to the inner row of desks. Or looking at the matter in another way, there are left only 5 of the 10,000 foot-candles Nature gave us for casual seeing out-of-doors.

Daylight should be depended on as much as possible, but its limitations must be acknowledged. The entire lighting problem must be approached from the standpoint of an acceptable standard of illumination for every pupil in the room, if we are to combat eye-strain and nearsightedness.

So rarely does the inner half of the room receive adequate natural light that the inner row of artificial lights must usually be burned throughout the day if 20 to 25 foot-candles are to be maintained. The accompanying picture shows the effect of one row of lights in supplementing daylight and building up the illumination level over the area where the amount of daylight is inadequate. The outer row of lights can then be controlled manually or automatically on dark, cloudy days as required.

The fact remains that existing artificial lighting in classrooms is woefully inadequate, in general providing less than 5 foot-candles, whereas in newer installations a level of 25 foot-candles has been accepted as a desirable minimum. Since this disparity introduces a problem of economical budgeting of operating costs, some



*How daylight should be augmented by using a part of the lighting installation.*

school authorities are installing higher wattage lamps to provide 20 to 25 foot-candles, offsetting this higher operating cost to a large extent by the saving which comes from having only half the lights burning; burning the outer row only when needed.

# Mercury Vapour Lamps

**By C. E. Weitz and W. G. Darley**

## Physical and Operating Characteristics

THE High Intensity Mercury Vapour Lamp utilizes the principle of the mercury vapour arc. It consists, essentially, of two main electrodes located at opposite ends of the 7½-inch glass tube in which the mercury that maintains the arc is vapourized. These electrodes are of tungsten wire, coiled and covered with barium-strontium-oxide which makes it possible for them to function satisfactorily at a correct temperature and for a long useful life.

*Starting.*

The arc tube contains a small amount of pure argon gas which is used as a conducting medium to facilitate the starting of the arc before the mercury is vapourized. Near the upper end of the tube is a starting electrode which is electrically connected to the lower electrode, and hence when current is applied, an electric field is set up between the starting electrode and the upper main electrode, causing an emission of electrons from the active surface of the main electrode. This imparts energy to the gas in the arc tube so that it becomes conducting.

The quantity of mercury in the arc tube is very carefully measured so as to maintain quite an exact vapour pressure, which incidentally, is about normal atmospheric pressure.

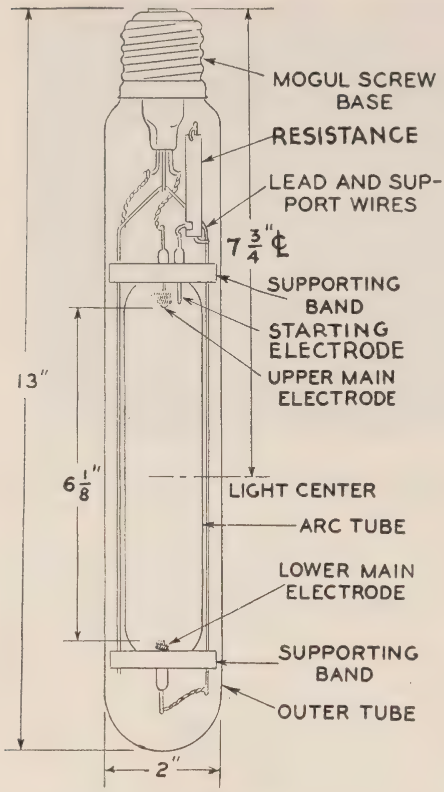



*Diagram of a High Intensity Mercury Vapur Lamp*

The 400-watt arc tube is enclosed in a larger tubular bulb which makes the lamp less subject to the effect of surrounding temperature. About half an atmosphere of nitrogen is introduced in the space between the arc tube and the outer bulb.

*Burning Position.*

Because in most of its applications the lamp will be burned in a base-up position, the majority of these lamps are designed accordingly. They may be obtained, however, for base-down burning, the chief difference being that in a base-down burning lamp the arc tube is reversed so that the sealing tip is still at the top in order not to pocket any of the mercury, since this might interfere with its complete vapourizing. If all the mercury does not vapourize, the pressure of the mercury vapour will be less than normal, resulting in lower efficiency. The lamp must be operated in a vertical position in order to keep the arc stream in the centre of the tube. If the lamp is deviated from vertical more than ten degrees, the arc stream will bow until it touches the side of the tube and its 400 watts will quickly melt the glass and ruin the lamp.

*Auxiliary Equipment for 115- and 230-Volt Circuits.*

In the 400-watt size the lamp requires a starting voltage, under ordinary temperatures, within the range of 130 to 160 volts, and after coming to full brilliance operates at about 150 volts. To produce this starting and operating voltage either from 115- or 230-volt circuits requires auxiliary transformer or reactor equipment. In common with all arc sources, the High Intensity Mercury Vapour Lamp requires a ballast resistance or reactance to limit the current, in order to prevent the arc from "running away with itself" and burning out the lead wires. The transformer or reactor furnishes the ballast necessary for controlling the current.

On the 115-volt circuits, a transformer, or a transformer-condenser, provides the necessary voltage and ballast. Without the condenser the over-all power factor is 60-65 per cent. A transformer with a built-in condenser will result in a power factor of about 92 per cent., and in general

is to be recommended, but this is not essential in installations where consideration of the power factor is unimportant or where other means of general power factor correction are in use.

On 230-volt circuits the simplest auxiliary is an iron-core reactor connected in series with the lamp, which likewise gives a resultant power factor of 60-65 per cent. Where the power factor is to be corrected, a transformer-condenser combination or a reactor-condenser combination will give a resultant power factor of 90-95 per cent.

The auxiliary equipment is designed to be adaptable to all usual conditions, and hence the transformers for 115-volt circuits are tapped at 107, 115 or 123 volts; the 230-volt equipment is provided with taps for circuits having voltages of 208, 220, 230 and 240.

A separate transformer or reactor must be provided for each lamp. This equipment may be mounted near each individual lamp, or if more convenient, grouped in one or more banks and located at a distance from the lamps.

*Operation.*

As soon as the arc has struck, the lamp takes about 20 volts, 5 amperes. When the current flows, the argon arc is seen for about two minutes as a bluish glow that fills the entire arc tube. After a few minutes the voltage rapidly increases until the lamp reaches a stable operating condition in about 10 or 12 minutes, at which time all of the mercury is completely vapourized. The lamp now operates at about 150 volts, 2.9 amperes. At this stage the arc no longer fills the tube but is concentrated to a pencil-like arc stream of high intensity. At full brilliance the lamp produces approximately 14,000 lumens.

The lamps have a very satisfactory performance as far as light output during life is concerned. At the end of rated life their light output in percentage of the initial lumens is at least comparable with that produced by corresponding Tungsten incandescent lamps.

If the current is interrupted while the lamp is in operation, the lamp cannot be re-lighted until it has cooled enough to reduce the mercury vapour pressure sufficiently to allow the arc to strike again, which will occur automatically if the current is on. This may require from five to fifteen minutes, depending on the conditions of operation. This characteristic of the lamp in some applications is likely to be a disadvantage, for example, in a photographic studio or other intermittent service where lamps are often switched on and off. However, where lamps are used continuously for extended periods, as they are in industrial interiors, no inconvenience because of this characteristic has been reported from the many installations already in service.—*The Magazine of Light.*

## Resuscitation Medal Presented to George Will

On August 15th, 1935, at 10.50 in the evening, E. B. Merrill while working in the radio transmitting station of CFRB north of Toronto, came in contact with apparatus alive at 8,000 volts and received a severe electrical shock and burn. He was cleared from the current and found to be not breathing and apparently lifeless.

George Will an employee of the Construction Department of the H.E.P.C. who was in the building, on hearing the roar of the flash rushed to Mr. Merrill's assistance and started artificial respiration. In about ten or twelve minutes there were some signs of life and in from fifteen to twenty minutes Mr. Merrill was breathing without assistance. He was taken to the hospital and made a complete recovery except that his burns were rather extensive and deep.

As the accident and resuscitation had taken place in a radio broadcasting station, it was felt quite appropriate that the presentation of the Canadian Electrical Association Resuscitation Medal, awarded to Mr. Will should be presented in the broadcasting studio.

At 8.15 p.m. on Tuesday, December 3rd, 1935, the presentation was made over CFRB and acting on behalf of R. B. Baxter, President of the Canadian Electrical Association, Wills Maclachlan presented the medal. Mr. Will ably acknowledged receipt of the medal and was congratulated by David Forgan, Department Head of the Construction Department. Mr. Forgan also read a letter that had been written to Mr. Will by T. Stewart Lyon, Chairman of the Commission, congratulating Mr. Will on behalf of the Commission.

*George Will*

Mr. Maclachlan outlined the details of artificial respiration for the benefit of the general public and advised the public that should they need any further information in connection with artificial respiration they should ask any employee of an electrical public utility in Ontario, as they are able to supply the desired information.

# Power from the Sun

By E. D. Wilson, Photo Electricity Div., Research Laboratories, Westinghouse Electric and Manufacturing Company

IT has long been a dream of men to harness the stupendous radiant energy from the sun. Indeed, solar machines have been invented and operated, but the investment per kilowatt output has always been discouragingly high and the absolute efficiency discouragingly low. Thus, when Bruno Lange announced a few years ago that he had obtained appreciable current from an improved photovoltaic cell, the world was once more all agog, and dormant hopes of direct power conversion were again aroused. Yet by his own analysis it turned out that the investment per kilowatt capacity was not competitive with conventional methods of power generation.

The photovoltaic cell is truly a direct converter of radiant energy into electrical energy. The action of light in the cell is to cause an immediate and continuous displacement of electrons through an internal plane. When the conducting media on opposite sides of the plane are connected externally through a load resistance, a corresponding current flows. When Lange first made his announcement in 1930, the maximum power output of the unit in full sunlight was of the order of one watt per square meter. Although the photovoltaic cell has been greatly improved technically, and its output at low levels of illumination greatly enhanced, it must still be recorded that its rating in direct sunlight remains of the same magnitude.

Mid-summer, mid-day sunlight may approach the value of one kilowatt per square meter on the earth's surface. Thus the over-all efficiency of available cells is about 0.1 per cent. It appears, therefore, that as a power converter the photovoltaic cell will not even prove interesting to the practical engineer until the efficiency has been increased at least 50 times. Even though the efficiency should be magically elevated to 100 per cent., Dr. Abbot has pointed out that it requires 10,000,000 square yards of solar radiation to be equivalent to the potential power of Niagara Falls.

After all, solar radiation is distributed over the face of the earth, and there is no means under the sun by which this dissipation can be undone. To convert any finite fraction of the energy requires a receiving unit of proportional area. And what could be a more satisfactory solution than to allow the far-flung radiation to evaporate water and raise it by convection currents above the hills, then let it condense and fall on the watersheds to be directed to the rivers that lead through giant turbine-generators?

The fact that the photovoltaic cell does not show promise as a power converter for solar energy does not detract from its great usefulness as an indicator of light intensity. Just as the thermometer is a convenient instrument for temperature indication, the photovoltaic cell is a logical and convenient instrument for the

measurement of light. Its power efficiency will certainly be greatly improved, but never enough to complete with natural conversion of solar heat.—*Power.*

# Personality and Supervision

**By W. D. Henderson, Dean, Extension Division, University of Chicago**

SINCE we live in a world of people the importance of personality should be obvious. Personality is a relationship that exists between one person and another. It is that something that makes the possessor stand out from the crowd. It is *not* something that you can carry around in your pocket and take a bite of when you feel like it.

It is allied with character. The arch of character is made up of honesty, self-respect, self-reliance, courage, courtesy and charity.

Charity joined with personality—like clasped hands—makes YOU.

Character is interior; personality, exterior.

The elements of strength—which is also a factor in personality—are presence, poise and power. Presence is determined by physical appearance. The man with commanding stature has a natural advantage. Poise is that quality whereby a person is sure of himself. Power comes with the definite knowledge that we can do things.

Four points should be considered in determining personality:

(1) The kind of clothes a man wears and how he wears them. For three months of the year I spend my time fishing up in Northern Michigan. I wouldn't be happy in anything else than those old faded overalls that I have worn up there each summer for years. They are not a part of the college professor, but most certainly they are a part of Henderson, the fisherman. Dress sensibly; and neatly.

(2) How he walks. Health and strength are revealed in the way a person carries himself. Watch how men lift their feet; how they swing their shoulders. Good bearing is a part of personality. Foremen should watch these things—and look out for slovenly posture, too.

(3) What he says and how he says it. The significance of the tongue is certainly an important factor in personality. Sometimes everything is perfectly lovely until a person opens his mouth. What one says is determined by what he knows. What are you foremen reading? How much time do you give to worth-while reading? This, too, is essential to personality.

And *how* you say it counts, also. It isn't necessary to be a crank on pronunciation. It is a threat to personality to be too perfect—because then it looks like pose. You do not have to be an expert in diction or pronunciation. No strict standard is necessary; but, on the other hand, let me say that the fellow who makes a habit of saying "I have went" and "I ain't" is marked just as effectively

as if he had a scar on his face. Men in supervisory positions certainly should realize the importance of at least reasonably good pronunciation and diction.

(4) Good manners. Manners enter into just about everything we do. Good manners certainly lubricate the machinery of personality. Back of good manners is courtesy.

And just remember this: It's how you deal with the people *below* that measures your real worth.—

—*The Industrial Supervisor.*

# A.M.E.U.
## Convention Programme

The programme of the winter convention of the Association of Municipal Electrical Utilities, which will be held at the Royal York Hotel, Toronto, is now practically completed. The proceedings will be after the following order:—

TUESDAY, January 28th, 1936

MORNING:

Registration.

10.30 o'clock—Convention Session. Reports of Committees.

AFTERNOON:

12.30 o'clock—Convention Luncheon.
Address.

2.30 o'clock—Convention Session.

Election of Officers for 1936.

The ballot will be closed immediately after this session is opened and the results of the election will be announced before it closes.

*Paper*—"Metal Clad Switchgear". by L. B. Chubbuck, Switchboard Engineer, Canadian Westinghouse Company, Limited, Hamilton.

*Paper*—"The Present Trend in Service Entrance Practice," by C. E. Schwenger, Distribution Engineer, Toronto Hydro-Electric System.

*Paper*—"Underground Distribution," by R. E. Jones, Distribution Section, Electrical Engineering Department, Hydro-Electric Power Commission of Ontario.

2.30 o'clock—Accounting Session.

The Committee on Accounting and Office Administration will conduct a separate session when matters pertaining to Accounting will be discussed.

EVENING:

6.30 o'clock—Convention Dinner. Entertainment. Address.

WEDNESDAY, January 29th, 1936

MORNING,

9.30 o'clock—Convention Session. Joint Session with the O.M.E.A.

*Paper*—"Public Relations," by W. J. Cairns, Division Manager, Bell Telephone Company, Toronto.

*Paper*—"Load Building Activities," by R. T. Jeffery, Chief Municipal Engineer, Hydro-Electric Power Commission of Ontario.

*Paper*—"Selling Industrial Electric Heating," by J. F. Tomlinson, Power Engineer, Toronto Hydro-Electric System.

AFTERNOON:

12.30 o'clock—Convention Luncheon. Address.

The delegates will join with the Electric Club of Toronto at their luncheon on this day.

2.30 o'clock—Convention Session.

*Paper*—"Looking Ahead in Lighting," by A. L. Powell, Supervis-

ing Engineer, Incandescent Lamp Department, General Electric Company, New York.

"Symposium of Lighting Promotional Activities," by Representatives of The Hydro-Electric Power Commission of Ontario, London Public Utilities Commission, Windsor Hydro-Electric System, Hamilton Hydro-Electric System and others.

*Paper*—"House Building Means Load Building," by J. F. Quinlan, Manager Demonstration Home Building Plan, General Electric Company, New York.

The annual meeting of the Ontario Municipal Electric Association will also be held at the Royal York Hotel, Toronto, on January 28th and 29th, 1936. Details of the programme of that Association are not yet available, beyond that of the joint session on the morning of January 29th and that the delegates of the two Associations will meet together for the convention luncheons and dinner.

## Election Ballot

The ballots for the election of officers for the Association of Municipal Electrical Utilities for the year 1936 will show the following as candidates:—

President: C. A. Walters, Napanee. (Acclamation).

Vice-President: V. A. McKillop, London; H. F. Shearer, Welland.

Secretary: S. R. A. Clement, H.E.P.C. of Ontario, Toronto. (Acclamation).

Treasurer: D. J. McAuley, H.E.P.C. of Ontario, Toronto; W. B. Munro, H.E.P.C. of Ontario, Toronto.

Directors—(*From the Membership at Large*): E. V. Buchanan, London: G. E. Chase, Bowmanville: W. H. Childs, Hamilton: J. E. B. Phelps, Sarnia: O. H. Scott, Belleville: R. J. Smith, Perth.

District Directors:

Niagara District—W. R. Catton, Brantford: H. G. Hall, Ingersoll: R. S. Reynolds, Chatham.

Georgian Bay District—C. E. Brown, Meaford: R. S. King, Midland.

Central District—R. O. Quick, Brighton: G. F. Shreve, Oshawa.

Eastern District—A. L. Farquharson, Brockville. (Acclamation).

Northern District—C. J. Moors, Fort William. (Acclamation).

The election ballots will be distributed during the morning of the first day of the convention and until the opening of the afternoon session on that day. Immediately after the afternoon session is opened the ballot will be closed and the results of the elections will be announced before that session is adjourned.

# Index to Volume XXII